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THE PHILIPPINE AGRICULTURIST

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THE COLLEGE COOPERATIVE CO., INC., BUSINESS FROM 1947 to 1953 [1]

WILLIAM L. FERNANDEZ [2]

WITH THREE TEXT FIGURES

The gross sales of the College Cooperative Co., Inc., increased each year from 1947 to 1953. The student enrollment at the College of Agriculture likewise increased. A greater volume of sales is possible by increasing the variety of commodities sold and by extending the business hours to early evening. These can be accomplished by employing a full-time paid manager. Items of expense should be properly classified and charged to the year in which such expenses were incurred. Any service rendered by an individual should be paid for.

The College Cooperative Co., Inc., was organized by the late President B. M. Gonzalez, Dr. Otto A. Reinking, and others in 1916 on the College of Agriculture campus, Los Baños, Laguna. The store was partially destroyed by bombing on December 25, 1941, and totally destroyed during the liberation in 1945. Through the efforts of some senior faculty members, like Dean L. B. Uichanco and Dr. F. O. Santos, the store was reopened after the liberation.

The writer, who managed the College Coop in 1952 and in 1953, compared the profit and loss statements of the years 1947 to 1953 (table 1) in order to analyze the business possibilities, policies, and management of the store. According to Foulke "the profit and loss statement is the mathematical interpretation of the policies, experience, knowledge, foresight, and aggressiveness of the management of a business enterprise from the point of view of income, expenses, gross profit, operating profit and net profit or loss. The final net profit or loss is the ultimate measure of the skill of the active management." [3]

The 1946 statement was omitted because it showed a net loss of ₱36.42. The 1947 profit and loss statement was used as the basis for comparison.

WHAT THE PROFIT AND LOSS STATEMENTS SHOW

Gross sales

The gross sales increased each year from 1947 to 1953. With the gross sales of 1947 considered as 100 per cent, the percentages

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[1] Central Experiment Station Contribution No. 1768. Read before the Los Baños Biological Club, July 30, 1954.

[2] The writer thanks Dr. L. S. Robertson, visiting professor of agricultural economics, Cornell-Los Baños Project, for going over the paper.

[3] Roy A. Foulke, "Practical Financial Statement Analysis," McGraw-Hill Book Company, Inc., New York, Toronto, London, 1950, 2nd ed., 713 pp.

[THE PHILIPPINE AGRICULTURIST, Vol. 38, No. 1, June, 1954 appeared in January, 1955.]
THE PHILIPPINE AGRICULTURIST, VOL 38, NOS. 2-3 JULY-AUGUST, 1954

of total sales in the successive years were 139, 186, 252, 287, 415, and 524 (fig. 1). The student enrollment at the College of Agriculture likewise increased. With the enrollment of 1947 considered as 100 per cent, enrollments in the successive years were 99, 117, 165, 278,

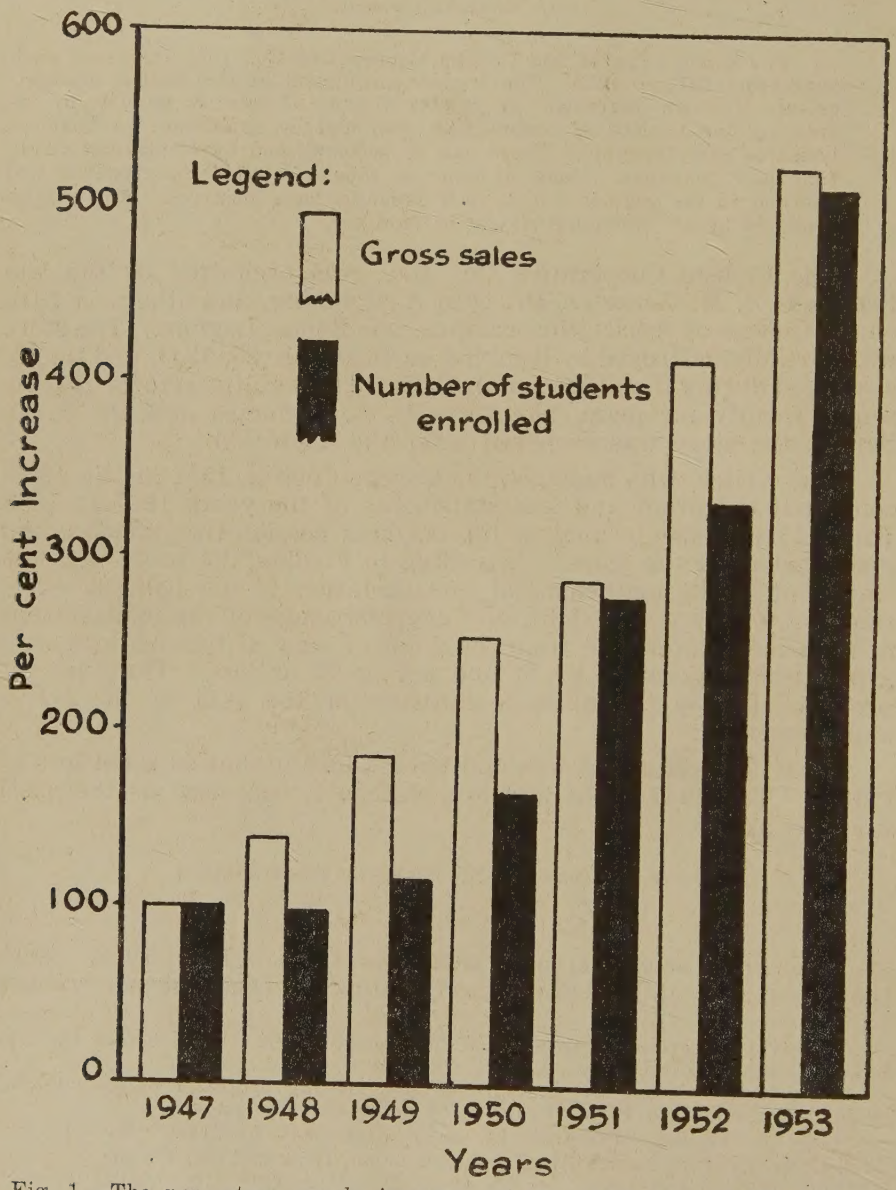

Fig. 1.—The percentage yearly increases of the gross sales of the College Cooperative Co., Inc., and of the number of students enrolled at the College of Agriculture. (Based on those of 1947 as 100 per cent).

333, and 513 per cent (fig. 1). The per capita gross sales from 1947 to 1953 were 30, 42, 48, 46, 31, 38, and 31 pesos (fig. 2).

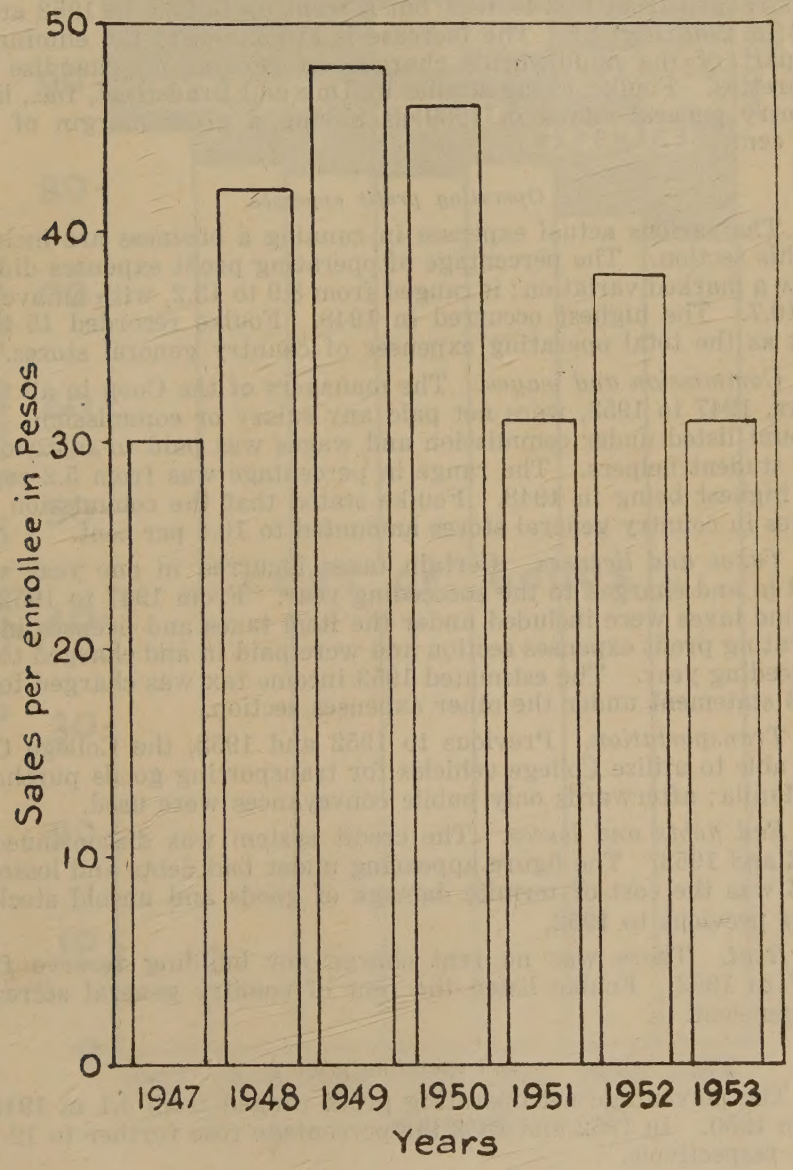

Fig. 2.—Gross sales per capita at the College of Agriculture from ture from 1947 to 1953.

Gross profit on sales

The difference between gross sales and cost of sales is the gross profit on sales. From 1947 to 1951, the percentage gross profit on sales ranged from 14.2 to 18.9, but it went up to 22.5 in 1952 and to 25.3 in 1953 (fig. 3). The increase is attributed to the elimination of part of the middlemen's charges on general merchandise and cigarettes. Foulke, citing studies by Dun and Bradstreet, Inc., listed country general stores in 1939 as having a gross margin of 17.9 per cent.

Operating profit expenses

The various actual expenses in running a business are included in this section. The percentage of operating profit expenses did not show a marked variation; it ranged from 8.9 to 13.2, with an average of 10.7. The highest occurred in 1948. Foulke recorded 15.4 per cent as the total operating expenses of country general stores.

Commission and wages. The managers of the Coop in all these years, 1947 to 1953, were not paid any salary or commission. The amount listed under commission and wages was paid to saleswomen and student helpers. The range in percentage was from 5.2 to 7.3, the highest being in 1948. Foulke stated that the commission and wages in country general stores amounted to 10.4 per cent.

Taxes and licenses. Certain taxes incurred in one year were paid in and charged to the succeeding year. From 1947 to 1952, all income taxes were included under the item taxes and licenses in the operating profit expenses section and were paid in and charged to the succeeding year. The estimated 1953 income tax was charged to the 1953 statement under the other expenses section.

Transportation. Previous to 1952 and 1953, the College Coop was able to utilize College vehicles for transporting goods purchased in Manila; afterwards only public conveyances were used.

Bad debts and losses. The credit system was discontinued in 1952 and 1953. The figure appearing under bad debts and losses in 1953 was the cost of termite damage of goods and unsold stock of years previous to 1952.

Rent. There was no rent charge nor building reserve from 1947 to 1953. Foulke listed the rent of country general stores as 2.2 per cent.

Net operating profit

The percentage net operating profit ranged from 4.1 in 1948 to 9.0 in 1950. In 1952 and 1953 the percentage rose further to 12 and 13.5, respectively.

Other expenses

No other expense item was recorded from 1947 to 1949 so that the net operating profit was also considered as the net profit of the

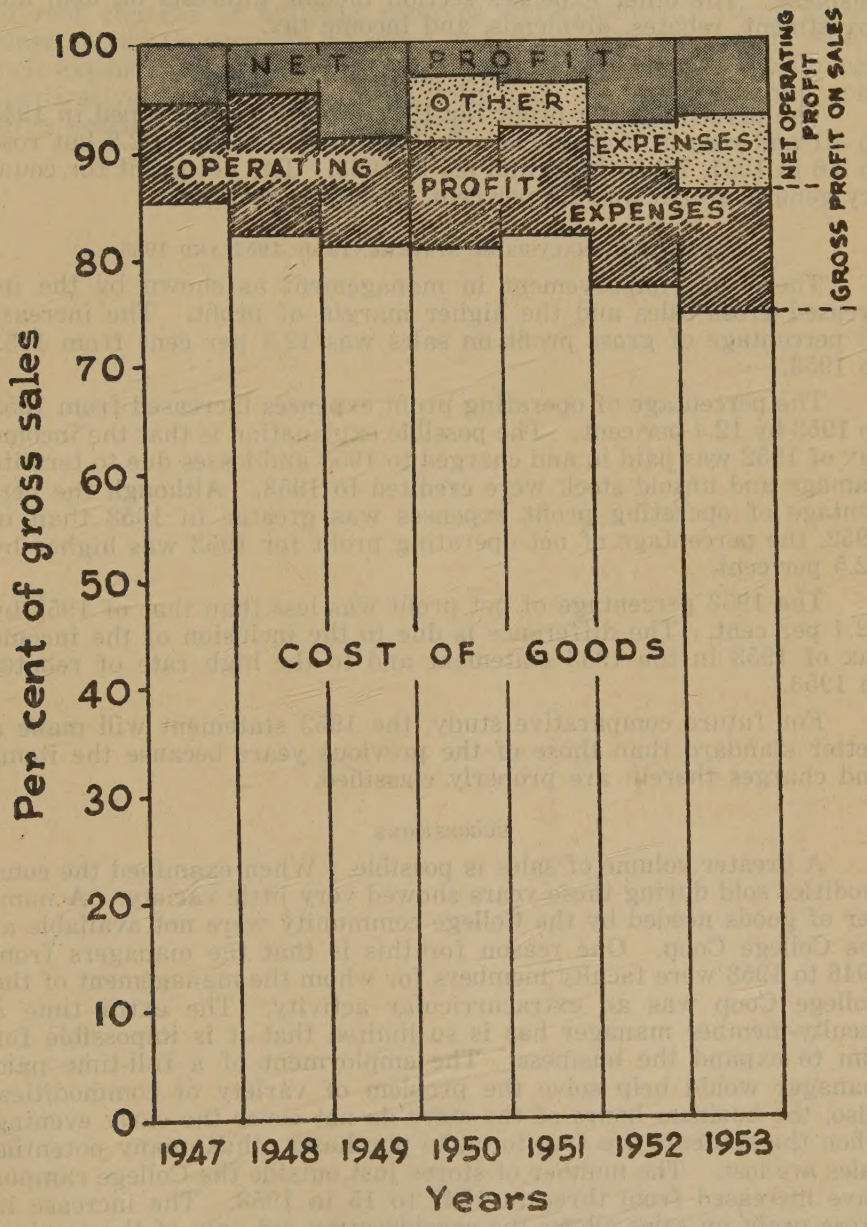

Fig. 3.—The relationship of the various sections in the profit and loss statements from 1947 to 1953. (Based on the gross sales as 100 per cent).

business. The other expenses section include interests on loan and investment, rebates, dividends, and income tax.

Net profit

The percentage net profit for 1947 was 5.3. It dropped in 1948 to 4.1 and rose in 1949 to 8.3. In 1950 it nose-dived to 2.9 but rose to 3.6 in 1951, 7.3 in 1952, and 6.4 in 1953. The net profit for country general stores was 2.5 per cent, according to Foulke.

COMPARATIVE ANALYSIS OF STATEMENTS OF 1952 AND 1953

There was improvement in management as shown by the increased gross sales and the higher margin of profit. The increase in percentage of gross profit on sales was 12.4 per cent from 1952 to 1953.

The percentage of operating profit expenses increased from 1952 to 1953 by 12.4 per cent. The possible explanation is that the income tax of 1952 was paid in and charged to 1953 and losses due to termite damage and unsold stock were credited to 1953. Although the percentage of operating profit expenses was greater in 1953 than in 1952, the percentage of net operating profit for 1953 was higher by 12.5 per cent.

The 1953 percentage of net profit was less than that of 1952 by 12.4 per cent. The difference is due to the inclusion of the income tax of 1953 in the 1953 statement and to the high rate of rebates in 1953.

For future comparative study, the 1953 statement will make a better standard than those of the previous years because the items and charges therein are properly classified.

SUGGESTIONS

A greater volume of sales is possible. When examined the commodities sold during these years showed very little variety. A number of goods needed by the College community were not available at the College Coop. One reason for this is that the managers from 1946 to 1953 were faculty members for whom the management of the College Coop was an extracurricular activity. The extra time a faculty-member manager has is so limited that it is impossible for him to expand the business. The employment of a full-time paid manager would help solve the problem of variety of commodities. Also, the business hours of the store do not cover the early evening when the students are free to make purchases; thus, many potential sales are lost. The number of stores just outside the College campus have increased from three in 1947 to 15 in 1953. The increase in gross profit on sales allows the consideration not only of the employment of a full-time paid manager but also the reduction of the prices of commodities.

The operating profit expenses were low because no salaries were paid to the managers and other individuals rendering service to the

business. College transportation was utilized free up to 1951, and no rent charges or building reserves were credited. Items of expense should be properly classified and charged to the year in which such expenses were incurred. It is difficult to compare the College Cooperative Co., Inc., statements with those of similar business concerns because of these discrepancies.

TABLE 1

Profit and loss statements (1947–1953) of the College Cooperative Co., Inc.

	1947		1948		1949		1950	
	Amount in pesos	Per cent [a]	Amount in pesos	Per cent [a]	Amount in pesos	Per cent [a]	Amount in pesos	Per cent [a]
Gross sales	10,011.51	100.0	13,931.38	100.0	18,607.80	100.0	25,232.78	100.0
Cost of goods	8,587.53	85.8	11,513.49	82.6	15,103.70	81.2	20,476.22	81.1
Gross profit on sales	1,423.98	14.2	2,417.89	17.4	3,504.10	18.8	4,756.56	18.9
Operating profit expenses								
Commission and wages	563.50	5.6	1,009.30	7.3	1,161.21	6.2	1,307.42	5.2
Taxes and licenses	60.00	0.6	155.81	1.1	142.31	0.7	222.80	0.9
Transportation	132.35	1.3	73.50	0.5	86.70	0.5	93.90	0.4
Supplies	31.40	0.3	—	—	206.12	1.1	221.15	0.9
Depreciation	7.65	0.1	227.58	1.6	222.44	1.2	265.95	1.0
Repair of fixtures	—	—	—	—	—	—	43.02	0.2
Bad debts and losses	5.99	0.1	42.00	0.3	68.44	0.4	230.00	0.9
Current consumption	—	—	—	—	—	—	—	—
Manager's traveling expenses	—	—	—	—	—	—	—	—
Manager's bonus	—	—	—	—	—	—	50.00	0.2
Miscellaneous	88.42	0.9	333.18	2.4	78.85	0.4	60.26	0.2
Total	889.31	8.9	1,841.37	13.2	1,966.07	10.5	2,494.50	9.9
Net operating profit	534.67	5.3	576.52	4.1	1,538.03	8.3	2,262.06	9.0
Other expenses								
Interest on loan	—	—	—	—	—	—	19.50	0.1
Interest on investment	—	—	—	—	—	—	496.75	2.0
Rebates, current	—	—	—	—	—	—	600.00	2.4
Rebates, accrued	—	—	—	—	—	—	406.60	1.6
Dividends	—	—	—	—	—	—	—	—
Income tax (estimated)	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	1,522.85	6.4
Net profit	534.67	5.3	576.52	4.1	1,538.03	8.3	739.21	2.6

[a] All items are expressed as percentages of gross sales.

TABLE 1 (continued)

	1951		1952		1953	
	Amount in pesos	Per cent [a]	Amount in pesos	Per cent [a]	Amount in pesos	Per cent [a]
Gross sales	28,717.83	100.0	41,560.56	100.0	52,427.61	100.0
Cost of goods	23,555.28	82.0	32,216.99	77.5	39,173.04	74.7
Gross profit on sales	5,162.55	18.0	9,343.57	22.5	13,254.57	25.3
Operating profit expenses						
Commission and wages	1,980.07	6.9	2,801.38	6.7	3,123.13	6.0
Taxes and licenses	306.00	1.1	446.67	1.1	558.60	1.0
Transportation	49.26	0.2	58.54	0.1	118.24	0.2
Supplies	129.90	0.5	360.43	0.9	404.09	0.8
Depreciation	238.68	0.8	87.56	0.2	795.93	1.5
Repair of fixtures	45.90	0.2	—	—	—	—
Bad debts and losses	—	—	—	—	194.88	0.4
Current consumption	—	—	—	—	331.35	0.6
Manager's traveling expenses	—	—	—	—	135.00	0.2
Manager's bonus	50.00	0.2	50.00	0.1	150.00	0.3
Miscellaneous	132.35	0.5	548.54	1.3	391.70	0.7
Total	2,932.16	10.2	4,353.12	10.5	6,202.92	11.8
Net operating profit	2,230.39	7.8	4,990.45	12.0	7,051.65	13.5
Other expenses						
Interest on loan	—	—	—	—	—	—
Interest on investment	568.48	2.0	551.92	1.3	613.81	1.2
Rebates, current	624.33	2.2	1,254.51	3.0	1,722.80	3.3
Rebates, accrued	—	—	—	—	—	—
Dividends	—	—	150.00	0.4	50.00	0.1
Income tax (estimated)	—	—	—	—	1,287.57	2.5
Total	1,192.81	4.2	1,956.43	4.7	3,674.18	7.1
Net profit	1,037.58	3.6	3,304.02	7.3	3,377.47	6.4

[a] All items are expressed as percentages of gross sales.

MATURITY PERIODS OF SELECTED MILLER'S SEEDLING CLONES OF SWEET POTATO IN THE WET SEASON [1]

MANUEL T. PERIGUA

WITH ONE TEXT FIGURE

The 10 selected Miller's seedling clones differed in maturity period. In terms of yield of marketable tubers in the different growing periods, M.S.P. 11, M.S.P. 14, M.S.P. 8, and M.S.P. 21 may be classified as early-maturing varieties, M.S.P. 12, M.S.P. 1, M.S.P. 10, M.S.P. 13, and M.S.P. 3 as medium-late varieties, and M.S.P. 2 as a late-maturing variety. M.S.P. 10, the best yielder, gave a computed yield of 29,167.25 kilograms to a hectare, as against the 5,000.10 kilograms of Palawan No. 2 and the 14,000.28 kilograms of Samar Big Yellow. The average size of tubers consistently increased with the lengthening of the growing period.

M.S.P. 10, M.S.P. 14, and Samar Big Yellow had a good eating quality; they were mealy and dry, soft, sweet, and not fibrous. The damage caused by pests and diseases to M.S.P. 10 clones was negligible. The yield of vines of the 12 clones was greatest after 60 days.

One of the breeding methods in the improvement of sweet potato is the production of seedling clones from crosses of desirable parental stocks. A number of important varieties have been developed in southern United States with this method.

From Dr. Julian Miller, a recognized sweet potato breeder and head of the Horticulture Section of Louisiana State University, 229 seeds of sweet potato were received by the College. The seeds were planted on December 30, 1950. Although 168 seedlings grew from the batch of seeds, only 159 were selected for transplanting in the field from March 9 to 12, 1951. The seedlings were planted singly in hills spaced 1½ meters apart. The plants were dug on August 23, 1951, and their individual performance was studied. Twenty-five clones which were good yielders and had good tuber characteristics were selected by Messrs. L. Bondoc and T. Eugenio for testing in replicated plots from August 30, 1951, to April 1, 1952. From among the 25 clones after the replicated test, 10 were selected by Messrs. L. G. Gonzalez, D. L. Umali, and L. Bondoc for yield, tuber color, flesh texture, and sweetness.

The maturity periods of the 10 clones in the wet season were evaluated at the Central Experiment Station from May, 1953, to February, 1954. A horticultural description of each clone was also made.

MATERIALS AND METHODS

The 10 clones tested were M.S.P. 1, M.S.P. 2, M.S.P. 3, M.S.P. 8, M.S.P. 10, M.S.P. 11, M.S.P. 12, M.S.P. 13, M.S.P. 14, and

[1] Central Experiment Station Contribution No. 1769. Thesis presented for graduation, April, 1954, with the degree of Bachelor of Science in Agriculture. Prepared in the Department of Agronomy under the direction of Drs. L. G. Gonzalez and D. L. Umali.

M.S.P. 21. Samar Big Yellow, a late-maturing variety,[2] and Palawan No. 2, an early variety,[3] were used as checks.

Plantings were made on ridges 1 meter apart and prepared in the usual upland method. One shoot cutting, 50 centimeters long, was planted in each hill. Two-thirds of the cutting was covered during the planting; the terminal portion was left exposed. All the plots were planted in one day. Replantings were made four days later.

The split block design with four replications was used in the field. A plot consisted of five rows—two border rows, one on each side, and three subplots. The plot for each clone was divided into three subplots to represent three growing periods: 60 days, 90 days, and 120 days after the date of planting. Each subplot was composed of eight hills. The yield of each subplot was based on only six hills; the hills at both ends were discarded.

The field was cultivated once and weeded three times. Insect and disease damage on the vines was observed. The general vigor of each clone was also noted.

For each clone, harvests were made 60 days, 90 days, and 120 days after planting. One subplot was dug for each harvest period. Before the tubers were dug, the vines from each subplot were cut, bundled, and weighed. The harvested tubers from six hills were washed thoroughly, weighed, and classified into marketable and nonmarketable ones. Marketable tubers were those that were at least as big as a chicken's egg and were free from insect and disease damage. The classes were weighed separately, and the number of tubers in each was counted. The average size of tubers was determined by dividing the total weight of tubers by the total number of tubers.

The cooked tubers of the second harvest were studied for sweetness, softness and dryness of texture, and aroma.

The horticultural description of each clone was based on characteristics of leaf, stem, and flower, tuber yield, size, and eating quality.

EXPERIMENTAL RESULTS

Total weight of tubers. The total weight of tubers of the different clones harvested after each growing period is given in table 1. Although the analysis of variance shows that the yield differences due to clones were highly significant, they were not considered since each clone total was the sum of three growing periods. Inasmuch as the main object was to determine the maturity period of each clone, the data interpretation was confined to the variance due to periods and interaction between clones and periods.

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[2] V. C. Calma and F. S. Zamora, *Philippine Agriculturist*, 32, 215 (1949).

[3] J. S. Tolentino, "A Field Test of Six Varieties of Sweet Potato." (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture. 1951. Unpublished.)

The variation in yield of tubers of the three periods is highly significant. The total weights for the three periods of the clones were as follows: 60 days, 47.08 kg.; 90 days, 104.55 kg.; and 120 days, 128.30 kg. The L.S.M.D. for any two-period total was 17.7 kg. Evidently, the yield of all the clones was significantly more in the 90-day period than in the 60-day period and in the 120-day period than in the 90-day period.

The interaction between clones and periods was significant at the 5 per cent level, indicating that the clones had different maturity periods. With an L.S.M.D. of 1.276 kg. for any two period means of the same clone, Palawan No. 2, M.S.P. 11, M.S.P. 13, M.S.P. 3, and M.S.P. 21 had the same yield in any of the three growing periods.

M.S.P. 1, M.S.P. 2, M.S.P. 10, M.S.P. 14, and M.S.P. 8 yielded significantly more in the 90-day harvest than in the 60-day harvest. M.S.P. 12, M.S.P. 2, M.S.P. 10, M.S.P. 14, and M.S.P. 8 yielded significantly more in the 120-day period than in the 60-day period. M.S.P. 2, M.S.P. 10, and Samar Big Yellow yielded significantly more in the 120-day period than in the 90-day period. M.S.P. 21 yielded significantly more in the 90-day than in the 120-day harvest. In any of the three growing periods Samar Big Yellow and Palawan No. 2 yielded about the same.

The highest yields of M.S.P. 1 in the 90-day period and M.S.P. 2 and M.S.P. 10 in the 120-day period were significantly more than that of Palawan No. 2 in the 1120-day period.

The earliest maturing and best yielding clone was M.S.P. 10. After 90 days it had more or less attained its maximum yield. Its yields at 90 days and 120 days were about the same.

Weight of marketable tubers. The weight of marketable tubers in each growing period of the 12 clones is shown in table 2. The variance due to periods was highly significant. The total weight of all the clones at 60 days was 23.15 kg.; at 90 days, 85.75 kg.; and at 120 days, 111.60 kg. The L.S.M.D. for any two-period total was 13.82 kg., showing that the yields from the longer periods were significantly more than those from the shorter one.

The interaction between clones and periods was highly significant. With an L.S.M.D. of 0.10 kg. for any two-period means, M.S.P. 11, M.S.P. 14, M.S.P. 8, and M.S.P. 21 had the same yield in any of the three growing periods.

Palawan No. 2, M.S.P. 12, M.S.P. 1, M.S.P. 2, M.S.P. 10, M.S.P. 13, and M.S.P. 3 yielded significantly more in the 90-day period than in the 60-day period. Palawan No. 2, M.S.P. 12, M.S.P. 1, M.S.P. 2, M.S.P. 10, M.S.P. 13, M.S.P. 3, and Samar Big Yellow yielded significantly more in the 120-day period than in the 60-day period. M.S.P. 11 yielded significantly more in the 120-day period than in the two other periods. In any of the three growing periods, Samar Big Yellow and Palawan No. 2 yielded about the same.

The highest yields of M.S.P. 2, M.S.P. 10, and M.S.P. 3 after 120 days were significantly more than that of Palawan No. 2 after 120 days.

The earliest maturing clone and the best yielder of marketable tubers was M.S.P. 10. After 90 days it had more or less attained its maximum yield of marketable tubers. Its yields after 90 days and 120 days were about the same.

Weight of vines. The weight of vines harvested in each growing period of the 12 clones is shown in table 3. The variance due to periods was not significant; the same was true of the interaction of clones and periods. The period means of the different clones for 60 days, 90 days, and 120 days were about the same. There was no appreciable increase in yield of vines after 60 days for all the clones.

Average size of tubers. There was a consistent increase in size of tubers with the lengthening of the growing period (table 4). After 120 days, M.S.P. 1 had the highest average weight of tubers; Samar Big Yellow, the second highest; and M.S.P. 21, the lowest.

Pests and diseases. The tubers were damaged by sweet potato weevil, *Cylas formicarius* Fabr.[4] None of the tubers were attacked within 60 days. After 90 days the damage was negligible, but after 120 days the damage was considerable especially on clone M.S.P. 10. The percentage of insect damage ranged from 0 to 8.8 per cent. The least damage was on M.S.P. 21 and the most was on M.S.P. 10.

Even after 120 days, the damage due to tuber rot of sweet potato caused by an unidentified species of bacterium [5] was still insignificant.

Eating quality. After 60 days, not all the clones had roots available for a test of their eating quality. At this age most of the roots were still immature; they were watery and not sweet. In the second harvest, there were enough root samples from each clone for cooking. M.S.P. 10, M.S.P. 14, and Samar Big Yellow were liked best by the panel of testers because they were mealy and dry, soft, sweet, and not at all fibrous; their flesh colors were also attractive (table 6). The others were either watery and not sweet or sweet but watery.

Horticultural description. The tubers differed not only in size and shape but also in color of the skin (fig. 1, upper panel, and table 6). Samar Big Yellow, M.S.P. 1, M.S.P. 3, and M.S.P. 13 had rugged and rough skins, whereas M.S.P. 11, M.S.P. 2, M.S.P. 8, M.S.P. 12, M.S.P. 10, M.S.P. 14, M.S.P. 21, and Palawan No. 2 had smooth skins.

The different clones could easily be differentiated from one another through their vegetative characters. Their leaves differed in

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[4] Identified by Dr. S. M. Cendaña of the Department of Entomology.

[5] Diseased specimens were examined by Dr. F. T. Orillo of the Department of Plant Pathology.

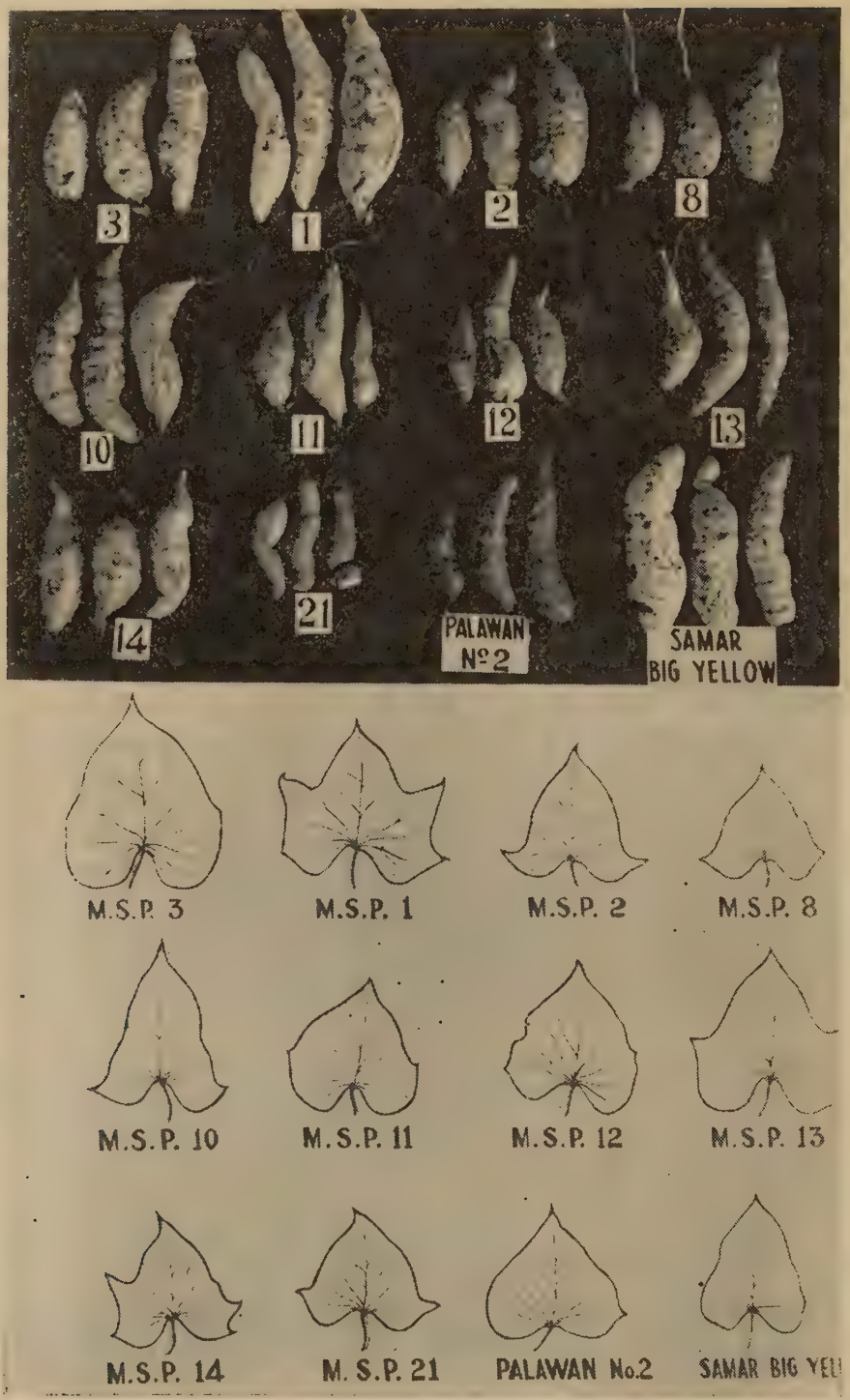

Fig. 1.—Upper panel, typical tubers of each clone after 90 days; lower panel, relative size, outline, and venation of fifth leaf from tip of vine of each variety. (*Photographed by Photographic Division.*)

size and shape (fig. 1, lower panel), in number and position of apex lobes, and in degree of hairiness. The flowers also differed in color.

M.S.P. 21 and M.S.P. 14 were the only clones that did not flower.

DISCUSSION

It was not thought desirable to extend the growing period beyond 120 days because varieties that can be harvested in three months are preferred by sweet potato growers. Planting late-maturing varieties in the wet season does not leave enough time for the preparation of the land for the dry-season planting.

The 12 clones differed in their growing periods. Because they had about the same yields of marketable tubers in the three growing periods, Palawan 2, M.S.P. 11, M.S.P. 14, M.S.P. 8, and M.S.P. 21 may be classified as early clones. These clones can be harvested after 60 days; prolonging their growing period to 120 days will not appreciably increase their yield. Their yielding abilities, which were about the same, were comparatively lower after the 120-day period. Because there was no significant difference in their yields of marketable tubers in the second and third harvests, M.S.P. 12, M.S.P. 1, M.S.P. 10, M.S.P. 13, and M.S.P. 3 may be classified as medium-late varieties. Among them the best yielder was M.S.P. 10. M.S.P. 2 and Samar Big Yellow, which was reported to yield about 1.48 kg. to a hill after five months, may be classified as late-maturing varieties. Compared to M.S.P. 10, these two are poor yielders.

The weight of the vines was greatest after 60 days for all the clones. If the clones are grown primarily for silage, the vines of any of them can be harvested after two months. After two months, the vines of the different clones, which practically had the same vigor of growth, had totally covered the whole field.

TABLE 1

Total weight of tubers of the different clones harvested after the three growing periods [a]

CLONE	GROWING PERIOD	REPLICATION				CLONE TOTAL	CLONE PERIOD TOTAL	CLONE PERIOD MEAN	COMPUTED HECTARE YIELD
		1	2	3	4				
	days	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*
Palawan No. 2	60	3.60	1.40	0	2.40		7.40	1.85	12,333.58
	90	3.20	2.00	1.90	2.50		9.60	2.40	16,000.32
	120	2.60	2.00	2.10	3.20		9.90	2.48	16,500.33
						26.90			
M.S.P. 12	60	0	0.50	0	0.80		1.30	0.33	2,166.71
	90	1.20	1.90	2.00	0.90		6.00	1.50	10,000.20
	120	2.20	1.00	4.30	2.10		9.60	2.50	16,000.32
						16.90			
M.S.P. 1	60	0.90	1.00	0.60	0.50		3.00	0.75	5,000.10
	90	4.00	2.00	5.00	3.20		14.20	4.73	23,667.14
	120	2.80	5.90	1.50	3.10		13.30	3.33	22,167.11
						30.50			
M.S.P. 11	60	0.40	0	0	0		0.40	0.10	666.68
	90	1.00	0.50	1.50	2.00		5.00	1.25	8,333.50
	120	1.40	1.00	0.90	1.20		4.50	1.13	7,500.15
						9.90			
M.S.P. 2	60	0	1.50	0	0.90		2.40	0.60	4,000.08
	90	3.10	1.90	2.00	2.00		9.00	2.25	15,000.30
	120	5.00	5.30	3.60	4.30		18.20	4.55	30,333.94
						29.60			
M.S.P. 10	60	2.50	4.00	1.00	3.00		10.50	2.63	17,500.35
	90	5.10	4.10	7.00	4.00		20.20	5.05	33,667.34
	120	6.90	4.30	6.20	6.50		23.90	5.98	39,834.13
						54.60			
M.S.P. 13	60	0.70	3.70	3.50	2.50		10.40	2.60	17,333.68
	90	3.20	2.80	2.50	2.00		10.50	2.63	17,500.35
	120	4.40	2.20	3.10	3.20		12.90	3.08	21,500.43
						33.80			
M.S.P. 14	60	0	0	0	0		0	0	0
	90	1.35	1.20	1.00	1.20		4.75	1.16	7,916.83
	120	1.30	1.00	1.30	1.20		4.80	1.20	8,000.16
						9.55			

[a] Growing period refers to the number of days from planting to harvesting.

TABLE 1 (continued)

CLONE	GROWING PERIOD	REPLICATION 1	2	3	4	CLONE TOTAL	CLONE PERIOD TOTAL	CLONE PERIOD MEAN	COMPUTED HECTARE YIELD
	days	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*
M.S.P. 8	60	0	0	0	0		0	0	0
	90	1.10	1.00	0.80	1.00		3.90	0.98	6,500.13
	120	0.90	1.90	0.40	1.90		5.10	1.53	8,500.17
						9.00			
M.S.P. 3	60	1.50	3.00	1.00	2.50		8.00	2.00	13,333.60
	90	3.00	2.50	4.00	2.00		11.50	2.88	19,167.05
	120	2.40	4.20	4.20	3.80		14.60	3.65	24,333.82
						34.10			
M.S.P. 21	60	0	0.68	0	0		0.68	0.17	1,133.36
	90	1.40	0.75	0.60	0.35		3.10	0.78	5,166.77
	120	0.40	0.60	1.10	0.20		2.30	0.58	3,833.41
						6.08			
Samar Big Yellow	60	2.30	0	0.50	0.20		3.00	0.75	5,000.10
	90	1.80	0.90	1.90	2.20		6.80	1.70	11,333.56
	120	1.90	2.00	2.20	3.10		9.20	2.30	15,333.64
						19.00			
Replication total		73.55	68.73	67.70	69.95	279.93			

L.S.M.D. for any two-clone period means = 1.27 kg.
L.S.M.D. for any two-period total = 17.7 kg.

Analysis of variance

SOURCE		DF	SS	VARIANCE	COMPUTED F-VALUE	TABULAR F-VALUE .05	.01	REMARKS
	Clones	11	186.68	16.97	33.94	2.09	2.84	
	Replications	3	0.54	0.18	0.36	2.89	4.44	
Error (a)	Clones × Replications	33	16.44	0.50				
	Periods	3	72.66	36.33	44.30	3.13	4.92	Highly significant
	Clones × Periods	22	34.37	1.56	1.90	1.70	2.11	Significant
Error (b)	Replications × Periods Pers. × Clones × Reps.	72	58.77	0.82				
	Total	143	369.46					

[a] Growing period refers to the number of days from planting to harvesting.

TABLE 2

Weight of marketable tubers of the different clones harvested after the three growing periods [a]

CLONE	GROWING PERIOD	REPLICATION				CLONE TOTAL	CLONE PERIOD TOTAL	CLONE PERIOD MEAN	COMPUTED HECTARE YIELD
		1	2	3	4				
	days	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*
Palawan No. 2	60	1.50	0.50	0	1.00		3.00	0.75	5,000.10
	90	2.40	1.40	1.25	2.20		7.25	1.81	12,083.58
	120	2.50	1.60	1.90	2.70		8.70	2.18	14,500.29
						18.95			
M.S.P. 12	60	0	0.25	0	0.50		0.75	0.19	1,250.03
	90	1.00	1.50	1.60	0.80		4.90	1.23	8,166.83
	120	1.80	0.85	3.90	1.70		8.25	2.06	13,750.28
						13.90			
M.S.P. 1	60	0.50	0.60	0.25	0.25		1.60	0.40	2,666.72
	90	3.50	1.60	4.20	2.75		12.05	3.01	20,083.74
	120	2.60	4.80	1.25	2.80		11.45	2.86	19,083.72
						25.10			
M.S.P. 11	60	0.25	0	0	0		0.25	0.06	416.68
	90	0.85	0.20	1.30	1.60		3.95	0.99	6,583.47
	120	1.15	0.65	0.80	0.90		3.50	0.88	5,833.45
						7.70			
M.S.P. 2	60	0	1.00	0	0		1.00	0.25	1,666.70
	90	2.75	1.65	1.50	1.50		7.40	1.85	12,333.58
	120	4.50	4.80	3.00	3.70		16.00	4.00	26,667.20
						24.40			
M.S.P. 10	60	1.50	2.50	0.50	1.50		6.00	1.50	10,000.20
	90	4.20	3.80	6.00	3.50		17.50	4.38	29,167.25
	120	6.00	3.95	5.00	6.00		20.95	5.24	34,917.37
						44.45			
M.S.P. 13	60	0.50	1.45	1.35	1.50		4.80	1.20	8,000.16
	90	2.90	2.35	2.30	1.60		9.15	2.29	15,250.31
	120	4.00	1.75	2.70	2.55		11.00	2.75	18,333.70
						24.95			
M.S.P. 14	60	0	0	0	0		0	0	0
	90	1.00	0.90	0.75	0.85		3.50	0.88	5,833.45
	120	1.05	0.85	1.10	1.00		4.00	1.00	6,666.80
						7.50			

[a] Growing period refers to the number of days from planting to harvesting.

TABLE 2 (continued)

CLONE	GROWING PERIOD	REPLICATION				CLONE TOTAL	CLONE PERIOD TOTAL	CLONE PERIOD MEAN	COMPUTED HECTARE YIELD
		1	2	3	4				
	days	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*
M.S.P. 8	60	0	0	0	0		0	0	0
	90	0.80	0.75	0.40	0.60		2.55	0.64	4,250.09
	120	0.75	1.60	0.20	1.50		4.05	1.01	6,750.14
						6.60			
M.S.P. 3	60	0.85	1.00	0.40	1.50		3.75	0.94	6,250.13
	90	2.40	2.20	3.60	1.80		10.00	2.50	16,667.00
	120	2.00	3.90	4.00	3.50		13.40	3.35	22,333.78
						27.15			
M.S.P. 21	60	0	0.30	0	0		0.30	0.08	500.01
	90	1.10	0.45	0.25	0.20		2.00	0.50	3,333.40
	120	0.30	0.40	1.00	0.20		1.90	0.48	3,166.73
						4.20			
Samar Big Yellow	60	1.50	0	0.20	0		1.70	0.43	2,833.39
	90	1.50	0.40	1.60	2.00		5.50	1.38	9,166.85
	120	1.60	1.80	2.00	3.00		8.40	2.10	14,000.28
						15.60			
Replication total		59.25	51.75	54.30	55.20	220.50			

L.S.M.D. for any two-clone period means = 1.0 kg.
L.S.M.D. for any two-period total = 13.82 kg.

Analysis of variance

SOURCE		DF	SS	VARIANCE	COMPUTED F-VALUE	TABULAR F-VALUE .05	TABULAR F-VALUE .01	REMARKS
	Clones	11	123.46	11.22	32.06	2.09	2.84	
	Replications	3	0.81	0.27	0.77	2.89	4.44	
Error (a)	Clones × Replications	33	11.67	0.35				
	Periods	2	86.18	43.09	86.18	3.13	4.92	Highly significant
	Clones × Periods	22	31.10	1.41	2.82	1.70	2.11	Highly significant
Error (b)	Replications × Periods Pers. × Clones × Reps.	72	35.89	0.50				
	Total	143	289.11					

TABLE 3

Weight of vines of the different clones harvested after the three growing periods [a]

CLONE	GROWING PERIOD	REPLICATION				CLONE TOTAL	CLONE PERIOD TOTAL	CLONE PERIOD MEAN	COMPUTED HECTARE YIELD
		1	2	3	4				
	days	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*
Palawan No. 2	60	2.10	3.30	6.00	5.00		16.40	4.10	27,333.88
	90	8.60	2.50	6.30	7.60		25.00	6.25	41,667.50
	120	4.10	3.50	4.00	5.20		16.80	4.20	28,000.56
						58.20			
M.S.P. 12	60	3.50	4.70	7.80	4.50		20.50	5.13	34,167.35
	90	3.00	3.60	6.80	7.10		20.50	5.13	34,167.35
	120	6.90	6.70	10.00	3.90		27.50	6.88	45,834.25
						68.50			
M.S.P. 1	60	4.10	2.10	7.70	4.80		18.70	4.68	31,167.29
	90	3.30	3.90	3.50	3.50		14.20	3.55	23,667.14
	120	3.40	4.00	2.50	5.00		14.90	3.73	24,833.83
						47.80			
M.S.P. 11	60	3.40	1.50	7.10	3.90		15.90	3.98	26,500.53
	90	2.30	2.70	6.70	4.50		16.20	4.05	27,000.54
	120	3.20	6.00	6.50	3.50		19.20	4.80	32,000.64
						51.30			
M.S.P. 2	60	3.80	4.70	4.70	4.60		17.80	4.45	29,667.26
	90	3.20	2.60	3.40	9.00		18.20	4.55	30,333.94
	120	3.90	4.20	4.90	7.70		20.70	5.18	34,500.69
						56.70			
M.S.P. 10	60	2.60	3.20	6.30	5.50		17.60	4.40	29,333.92
	90	4.10	2.30	11.00	6.40		23.80	5.95	39,667.46
	120	2.80	2.80	8.00	6.10		19.70	4.93	32,833.99
						61.10			
M.S.P. 13	60	3.70	5.30	7.50	3.90		20.40	5.10	34,000.68
	90	8.60	5.80	6.30	8.10		28.80	7.20	48,000.96
	120	7.00	5.00	8.50	4.50		25.00	6.25	41,667.50
						74.20			
M.S.P. 14	60	3.00	5.80	4.00	6.00		18.80	4.70	31,333.96
	90	3.20	7.40	2.00	4.20		16.80	4.20	28,000.56
	120	4.90	5.50	3.90	5.70		20.00	5.00	33,334.00
						55.60			

[a] Growing period refers to the number of days from planting to harvesting.

TABLE 3 (continued)

CLONE	GROWING PERIOD	REPLICATION 1	2	3	4	CLONE TOTAL	CLONE PERIOD TOTAL	CLONE PERIOD MEAN	COMPUTED HECTARE YIELD
	days	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*	*kg.*
M.S.P. 8	60	4.50	3.00	4.50	6.00		18.00	4.50	30,000.60
	90	3.50	3.30	4.50	5.30		16.60	4.15	27,667.22
	120	3.60	4.60	6.00	5.00		19.20	4.80	32,000.64
						53.80			
M.S.P. 3	60	4.00	3.50	7.00	5.30		19.80	4.95	33,000.66
	90	4.90	4.80	10.00	4.60		24.30	6.08	40,500.81
	120	2.50	5.50	6.00	6.00		20.00	5.00	33,334.00
						64.10			
M.S.P. 21	60	3.20	5.30	3.70	4.00		16.20	4.05	27,000.54
	90	4.80	4.60	4.20	2.60		16.20	4.05	27,000.54
	120	3.30	5.00	4.50	3.10		15.90	3.98	26,000.54
						48.30			
Samar Big Yellow	60	6.30	5.30	7.00	7.20		25.80	6.45	43,000.86
	90	6.40	2.40	7.40	9.30		25.50	6.38	42,500.85
	120	10.50	5.70	5.00	8.10		29.30	7.35	48,834.31
						80.60			
Replication total		156.20	152.10	215.20	196.70	720.20			

Analysis of variance

SOURCE	DF	SS	VARIANCE	COMPUTED F-VALUE	TABULAR F-VALUE .05	.01	REMARKS
Clones	11	95.80	8.71	1.76	2.09	2.84	
Replications	3	79.52	26.51	5.37	2.89	4.44	
Error (a) Clones × Replications	33	163.11	4.94				
Periods	2	6.32	3.16	1.55	3.13	4.92	Not significant
Clones × Periods	22	40.91	1.86	0.91	1.70	2.11	Not significant
Replications × Periods	72	146.72	2.04				
Error (b) Pers. × Clones × Reps.							
Total	143	532.38					

TABLE 4

Average weight of tubers of the different clones in the three growing periods [a]

CLONE	GROWING PERIOD		
	60 days	90 days	120 days
	grams	*grams*	*grams*
Palawan No. 2	150	181	189
M.S.P. 12	91	128	148
M.S.P. 1	166	247	267
M.S.P. 11	80	185	191
M.S.P. 2	70	180	186
M.S.P. 10	150	175	190
M.S.P. 13	145	175	188
M.S.P. 14	0	77	148
M.S.P. 8	0	128	162
M.S.P. 3	125	170	187
M.S.P. 21	75	107	115
Samar Big Yellow	125	232	233

[a] Average weight was determined by dividing the total weight of tubers by the number of tubers.

TABLE 5

Percentage of tubers attacked by pests and diseases in the three growing periods [a]

CLONE	GROWING PERIOD	ATTACKED BY PESTS	ATTACKED BY DISEASES
	days	*per cent*	*per cent*
Palawan No. 2	60	0	0
	90	1.75	0
	120	3.25	0
M.S.P. 12	60	0	0
	90	1.50	0
	120	2.20	0
M.S.P. 1	60	0	0
	90	1.60	0
	120	3.40	0
M.S.P. 11	60	0	0
	90	1.80	0
	120	3.80	0.40
M.S.P. 2	60	0	0
	90	1.70	0
	120	3.20	0.30
M.S.P. 10	60	0	0
	90	4.50	0
	120	8.80	0.80
M.S.P. 13	60	0	0
	90	1.40	0
	120	3.10	0
M.S.P. 14	60	0	0
	90	1.35	0
	120	3.50	0
M.S.P. 8	60	0	0
	90	1.60	0
	120	3.00	0
M.S.P. 3	60	0	0
	90	2.90	0
	120	4.20	0
M.S.P. 21	60	0	0
	90	1.10	0
	120	2.10	0
Samar Big Yellow	60	0	0
	90	2.10	0
	120	4.60	0

[a] Growing period refers to the number of days from planting to harvesting.

TABLE 6

Horticultural descriptions of the different clones

	PALAWAN NO. 2	M.S.P. 12	M.S.P. 1	M.S.P. 11
Stem:				
Color	Green without any brownish area	Green with purple around the axil of the leaves	Green with purple around the axil of the leaves	Green with purple around the axil of the leaves
Leaf:				
Color	Green	Green	Green	Green
Color of lower surface of veins	Green	Violet	Green	Violet
Dentation of base	Obtuse	Obtuse	Obtuse	Acute
Pubescence	On tip and along the veins	On tip and along the veins	All over	Hair absent
Number of apex lobes	Two	Two	Five	Three
Tuber:				
Color of skin	Purple	Cream	Yellowish white	Pinkish white
Color of flesh	Yellowish white	Pinkish yellow	Yellowish white	Orange
Presence of fiber	Not fibrous	Not fibrous	Fibrous	Fibrous
Shape of tuber	Long	Medium	Long	Medium
Presence of latex	With latex	With latex	With latex	With latex
Cooking quality of tuber:				
Texture	Watery	Watery	Watery	Watery
Sweetness	Not too sweet	Not too sweet	Not too sweet	Sweet
Softness	Soft	Soft	Soft	Soft
Average weight of marketable tubers in grams:				
Sixty days	150	91	166	80
Ninety days	181	128	247	185
One hundred and twenty days	189	148	267	191
Average yield of marketable tubers per hectare in tons:				
Sixty days	5.0	1.3	2.7	0.4
Ninety days	12.1	8.2	20.8	6.1
One hundred and twenty days	14.5	13.8	19.8	5.8
Flower:				
Number	Fairly numerous	Fairly numerous	Few	Few
Color	Purplish white	Purple	Purplish white	Purple

TABLE 6 (continued)

	M.S.P. 2	M.S.P. 10	M.S.P. 13	M.S.P. 14
Stem:				
Color	Green with purple around the axil of the leaves	Green without any brownish area	Green with purple around the axil of the leaves	Green with purple around the axil of the leaves
Leaf				
Color	Green	Green	Green	Green
Color of lower surface of veins	Green	Green	Green	Green
Dentation of base	Obtuse	Acute	Acute	Acute
Pubescence	Hair absent	On tip and along the veins	Hair absent	Hair absent
Number of apex lobes	Three	Three	Three	Five
Tuber:				
Color of skin	Pinkish orange	Orange	Pinkish yellow	Yellowish orange
Color of flesh	Pinkish white	Cream	Orange	Yellowish white
Presence of fiber	Fibrous	Not fibrous	Fibrous	Not fibrous
Shape of tuber	Short	Long	Long	Short
Presence of latex	With latex	With latex	With latex	With latex
Cooking quality of tuber:				
Texture	Watery	Mealy & dry	Mealy & dry	Mealy & dry
Sweetness	Sweet	Sweet	Not too sweet	Sweet
Softness	Soft	Soft	Soft	Soft
Average weight of marketable tubers in grams:				
Sixty days	70	150	145	0
Ninety days	180	175	175	77
One hundred and twenty days	186	190	188	148
Average yield of marketable tubers per hectare in tons:				
Sixty days	1.7	10.0	8.0	0
Ninety days	12.3	29.1	15.3	5.8
One hundred and twenty days	26.7	34.9	18.3	6.7
Flower:				
Number	Fairly numerous	Few	Few	None
Color	Purple	Purple	White outside and violet inside	None

(TABLE 6 (continued)

	M.S.P. 8	M.S.P. 3	M.S.P. 21	SAMAR BIG YELLOW
Stem:				
Color	Green without any brownish area	Green with purple around the axil of the leaves	Green without any brownish area	Green with purple around the axil of the leaves
Leaf:				
Color	Green	Green	Green	Pale green
Color of lower surface of veins	Green	Violet	Violet	Pale green
Dentation of base	Obtuse	Acute	Obtuse	Acute
Pubescence	Hair absent	On tip and along the veins	All over	Light all over
Number of apex lobes	Three	One	Three	One
Tuber:				
Color of skin	Pinkish yellow	Yellowish white	Pinkish yellow	Yellowish white, light buff to yellow
Color of flesh	Yellowish white	Yellowish white	Purple	Purple light ocherous salmon
Presence of fiber	Fibrous	Fibrous	Fibrous	Not fibrous
Shape of tuber	Short	Medium	Long	Long
Presence of latex	With latex	With latex	With latex	With latex
Cooking quality of tuber:				
Texture	Watery	Watery	Watery	Mealy & dry
Sweetness	Sweet	Sweet	Not too sweet	Sweet
Softness	Soft	Soft	Soft	Soft
Average weight of marketable tubers in grams:				
Sixty days	0	125	75	125
Ninety days	128	170	107	232
One hundred and twenty days	162	187	115	233
Average yield of marketable tubers per hectare in tons:				
Sixty days	0	6.3	0.5	2.8
Ninety days	4.3	16.7	3.3	9.2
One hundred and twenty days	6.8	22.3	3.2	14.0
Flower:				
Number	Few	Fairly numerous	None	Abundant
Color	Purple	Purplish white	None	Light violet

FERTILIZATION OF KENAF WITH AMMONIUM SULFATE [1]

MAXIMO S. BINOS

WITH ONE TEXT FIGURE

Two varieties of kenaf (*Hibiscus cannabinus* Linn.), *viridis* and *vulgaris*, were fertilized with ammonium sulfate at the rates of 100, 200, and 300 kg. a hectare. The plants tended to grow taller as the amount of fertilizer was increased. Ammonium sulfate had no pronounced effect on the branching of the stems or on the period of maturity. All the treatments, except the 100-kg. plots, yielded significantly more fiber than the control. The plants produced more capsules and seeds as they grew taller. The rate of fertilization did not significantly affect the tensile strength of the fiber.

A few years ago kenaf (*Hibiscus cannabinus* Linn.) was successfully grown for the first time in the UP College of Agriculture at Los Baños, Laguna, and in some parts of the Philippines.

In 1953, Jones *et al.*[2] reported that high contents of nitrogen and potash and moderate phosphorus in the soil produced an average yield of 83,600 pounds of kenaf fiber to a caballeria [3] (2,800.79 kg. to a hectare). They further stated that unfertilized plants produced low yields, but plants treated with ammonium sulfate and superphosphate combined gave consistently high yields, although variations in yield were observed in all the replications.

Daza [4] found that the 300- or 400-kg. rate of application of ammonium sulfate on ramie plants gave a significantly higher yield of dry fiber than the control. He also noted that the application of ammonium sulfate had no pronounced effect on the stalk branching of all the varieties of ramie plants used.

To determine the effect of ammonium sulfate applied at different rates on the yields of kenaf fiber and seeds, an experiment was conducted from May, 1953, to February, 1954, in the Central Experiment Station and in the Division of Fiber and Oil Crops.

MATERIALS AND METHODS

Preparation of the land. Lipa clay loam soil which had previously been planted to castor oil plants (*Ricinus communis* Linn.) plowed and harrowed twice. Immediately after the second harrow-

[1] Central Experiment Station Contribution No. 1770. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1954. Prepared in the Department of Agronomy under the direction of Associate Professor Pedro A. David.

[2] Jones *et al.*, *Ministerio de Agricultura Direccion de Estaciones Experimentales Comision Cooperativa de Fibras Circular Agricola*, 5 (1953).

[3] One caballeria is approximately 33.5 acres.

[4] David M. Daza, *Philippine Agriculturist*, 35, 1 (1951).

rowing, the field was divided into 32 plots with an area of 15 square meters each and spaced one meter apart.

Analysis of the soil in the Department of Soils showed that it contained 0.07 per cent total nitrogen, 13.1 ppm. of available phosphorus, 93 ppm. of available potash, and a pH value of 5.9.

Planting and fertilization. On May 7, 1953, 16 plots for fiber and 16 for seed production were planted to kenaf seeds of the varieties *vulgaris* and *viridis*. The seeds were obtained from Soriano y Cia., Manila. Based on the 22-kg. rate of seeding for seed production and the 34-kg. rate for fiber production,[5] about one kilogram of seeds (63 per cent germination) was planted in the plots for seed and about two kilograms in the plots for fiber production. The planting distances were 20 inches between rows and 2 inches between hills for the seed plots and 8 inches between rows and 2 inches between hills for the fiber plots.

Immediately after planting, ammonium sulfate containing 21 per cent nitrogen was spread evenly on each plot at the rate of 100 (21 kg. nitrogen), 200 (42 kg. nitrogen), and 300 kg. (63 kg. nitrogen) to a hectare, or 150,300, and 450 grams to a plot of 15 square meters.

Weeding and cultivation. The plots were weeded for three days after the third week following planting. Weeding was followed by cultivation with the use of a push-hand cultivator in the seed plots and a trowel in the fiber plots. Cultivation was completed in four days. The plots for seed production were weeded and cultivated twice; those for fiber production were weeded and cultivated only once since the plants were crowded and the rows close to each other.

Pests and diseases. Forty days after planting, the plants were attacked by *Anomis erosa* Hübner. During the blooming period, they were attacked by flea beetles, *Nisotra gemella* Erichson.[6] To check these infestations, the plants were sprayed with Gesarol, an emulsified DDT bought from Zuellig Inc., in the proportion of two spoonfuls to one gallon of rain water. Three sprayings were enough to drive away the insects.

Phoma blight caused by *Phoma sabdariffae* Sacc., which attacked the plants 22 days after planting, was easily checked by 530 Spraycop at 1 per cent concentration. From the time observation was begun on September 4, 1953, to the time when the plants were harvested on September 29, 1953, root knot of kenaf caused by *Heterodera radicicola* (Greef) Muller [7] was present.

Harvesting for fiber. The plants were cut at ground level and the branches were counted, tied in bundles, and weighed. Twenty representative plants were harvested from each plot at random. The stems were weighed after the leaves had been removed. The bark

[5] Tobias B. Manzano, *Philippine Agriculturist*, 35, 561 (1952).
[6] Identified by Dr. Silverio M. Cendaña of the Department of Entomology.
[7] Identified by Dr. Faustino T. Orillo of the Department of Plant Pathology.

was bundled, weighed, and submerged in a concrete tank filled with running water. Nine days later, the fibers were washed to remove the pulp, dried in the sun, and weighed.

Harvesting for seeds. The plants in the plots for seed production were harvested 179 days after planting, when the leaves were dry and the capsules mature. Twenty representative samples selected at random from each plot were carefully cut at ground level and measured. After the branches had been counted, each stem was cut just below the first-borne capsule. The capsules were threshed and the seeds from each counted.

Determination of tensile strength. The tensile strength of the fiber, expressed in breaking length, was computed by the following formula of Botkin, Shires, and Smith: [8]

$$\text{Tensile strength} = \frac{\text{Breaking load}}{\text{Weight of sample per cm.}}$$

The breaking load of single-fiber strands was determined with the Scott Testers IP-2 Tensilgraph machine. Ten trials were made for the fibers harvested from one plot.

RESULTS AND DISCUSSION

General appearance of plants. Plants in the fertilized plots grew more vigorously than those in the unfertilized ones. In general, fertilized plants had broader and greener leaves than the control. The plants grew taller as the rate of application was increased (fig. 1, left). At maturity, plants in the control plots suffered very much from flea beetle infestation, but the treated plants, except in the 100-kg. plots, were not severely affected. Apparently heavy fertilizer applications increased the resistance of plants to the attack of pests.

Height of plants. The average height of plants ranged from 251.32 to 313.00 cm. (table 1) in the fertilized plots for fiber production and from 258.65 to 327.47 cm. (table 2) in the fertilized plots for seeds. The tallest plants in the plots for fiber and seeds were those treated with 300 kg. to a hectare. The average increases in height of the plants from the different treatments over the control were as follows: 100 kg., 38.12 cm.; 200 kg., 75.14 cm.; and 300 kg., 100.00 cm.

Branching tendency. The application of ammonium sulfate had no significant effect on the branching of the plants. All the plants, including those for seed production, barely produced branches.

Maturity period. The index of maturity for fiber production in this experiment was the flowering of 50 per cent of the plants in a plot. Fertilization did not affect maturity. The plants from the treated plots, as well as those from the control, flowered at the

[8] C. W. Botkin, C. B. Shires, and E. C. Smith, *New Mexico Agric. Exper. Sta. Bull.*, 300 (1943).

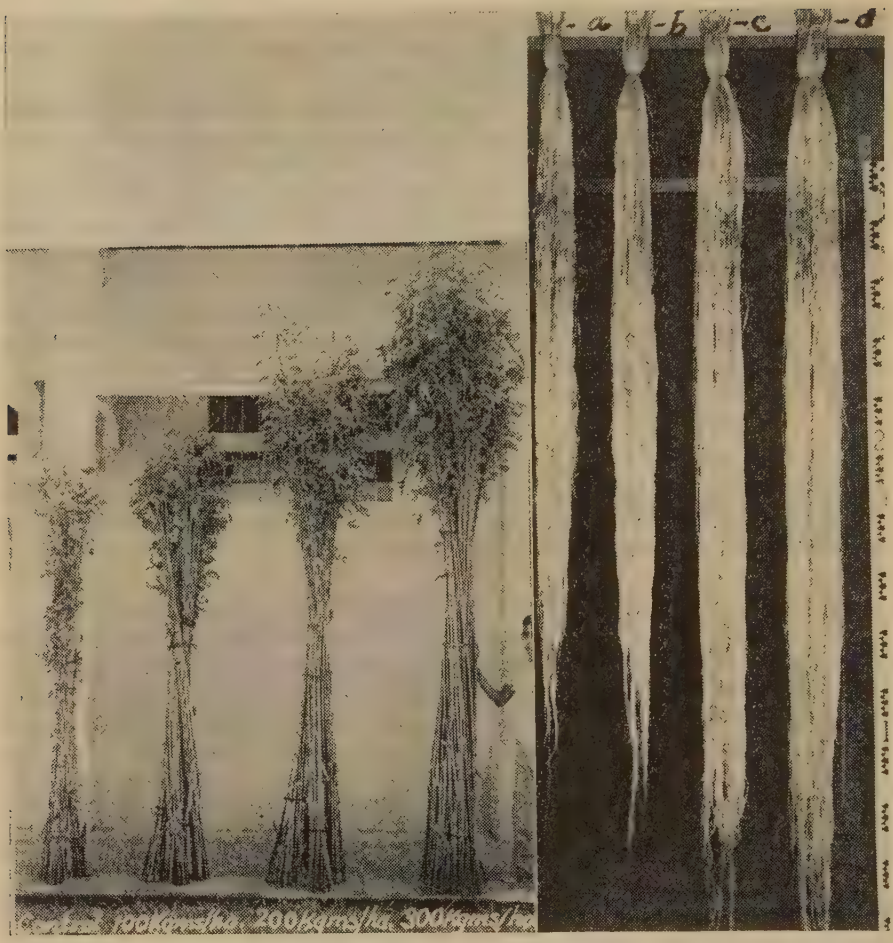

Fig. 1.—Left, kenaf plants newly harvested from plots fertilized with different amounts of ammonium sulfate; right, kenaf fibers extracted from plants fertilized with different amounts of ammonium sulfate: (a) control, (b) 100 kg., (c) 200 kg., and (d) 300 kg. (*Photo by Dr. Julian Banzon, Photographic Division.*)

same time—148 days after planting. The fertilizer probably affected the growth and vigor of the plants but not the length of maturity.

Yield of dry fiber. The average yield of dry fiber increased directly with the increase in amount of fertilizer (table 3). In length (fig. 1, right) and in amount of fiber produced, the control was inferior to any of the treated plots. Three hundred kilograms of fertilizer to the hectare produced significantly more and longer fibers than the other treatments.

Yield of capsules. Table 4 shows that the plants tended to produce more capsules as the amount of fertilizer was increased. The

plants from the control plots had low yields, their leaves being short and susceptible to the attack of insects. The plants in the treated plots were less disturbed; hence, they produced more capsules.

Yield of seeds. The increase in the number of capsules was followed by an increase in the number of seeds. Table 5 shows that the 300-kg. rate produced the highest average number of seeds, followed by the 200-kg. rate, the 100-kg. rate, and the control in descending order.

Tensile strength of fiber. The rate of application did not significantly affect the tensile strength of the fiber (table 6), although there was a tendency for the fiber to become stronger as the rate of application was increased. The strongest fiber was produced by plants fertilized with 300 kg. of ammonium sulfate to a hectare; the weakest fiber was produced by the control.

TABLE 1

Height in centimeters of kenaf plants grown for fiber as influenced by different amounts of ammonium sulfate

NUMBER OF PLANT	CONTROL				TREATMENT I			
	Replication				Replication			
	1	2	3	4	1	2	3	4
1	240	266	214	190	297	258	255	164
2	248	250	219	167	235	283	200	254
3	241	226	192	175	250	261	234	224
4	232	260	220	170	272	249	249	242
5	225	251	182	190	297	258	264	246
6	247	210	200	200	257	290	258	218
7	248	239	223	192	263	237	263	206
8	250	230	210	155	278	279	232	231
9	246	215	229	200	290	260	251	204
10	230	239	230	178	200	280	273	230
11	237	208	218	196	305	242	255	228
12	223	260	208	157	251	231	274	218
13	236	164	225	193	269	265	259	249
14	228	245	216	200	290	277	261	243
15	245	238	246	179	283	310	200	203
16	181	226	233	137	264	269	261	171
17	242	200	185	126	261	292	241	220
18	237	193	246	163	270	245	262	206
19	239	209	221	182	271	278	234	240
20	236	230	132	187	259	276	237	244
Total	4711	4559	4249	3537	5362	5340	4963	4441
Replication mean	235.55	227.95	212.45	176.85	268.10	267.00	248.15	22.05
Treatment mean				213.20				251.33

TABLE 1 (continued)

NUMBER OF PLANT	TREATMENT II				TREATMENT III			
	Replication				Replication			
	1	2	3	4	1	2	3	4
1	287	285	281	331	255	347	370	367
2	275	280	308	330	275	282	344	310
3	312	244	315	350	277	346	276	348
4	300	300	259	286	317	356	340	335
5	305	325	300	257	272	316	300	371
6	300	281	276	282	243	250	326	342
7	285	330	330	285	337	286	377	320
8	291	270	314	277	273	293	383	308
9	270	285	294	260	264	300	341	258
10	300	269	279	300	310	271	382	295
11	276	287	271	331	282	279	359	391
12	310	273	290	320	285	300	315	294
13	250	281	348	274	283	288	360	325
14	281	264	281	345	300	269	312	315
15	286	274	297	240	295	294	361	308
16	267	286	283	278	289	345	248	316
17	296	247	321	256	290	277	305	309
18	300	280	300	255	309	300	337	365
19	315	269	278	265	262	302	332	372
20	290	254	280	281	281	300	362	361
Total	5796	5584	5905	5803	5699	6001	6730	6610
Replication mean	289.80	279.20	295.25	290.15	284.95	300.05	336.50	330.50
Treatment mean				288.60				313.00

TABLE 1 (continued)

REPLICATION	1	2	3	4	TOTAL	MEAN
I	4,711	5,362	5,796	5,699	21,568	5,392.00
II	4,559	5,340	5,584	6,001	21,484	5,371.00
III	4,249	4,963	5,905	6,730	21,847	5,461.75
IV	3,537	4,441	5,803	6,610	20,391	5,097.75
Total	17,056	20,106	23,088	25,040	85,290	
Mean	4,264.00	5,026.50	5,772.00	6,260.00		

Analysis of variance

SOURCE OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE 5%	TABULAR F-VALUE 1%
Replication	3	15,364.31	5,121.44			
Treatment	3	457,746.14	152,582.05	14.88	3.86	6.99
Replication × Treatment	9	92,287.94	10,254.22			
Sampling error	304	190,831.30	627.73			
Total	319	756,229.69				

L.S.M.D. = 36.22

TABLE 2

Height in centimeters of kenaf plants grown for seeds as influenced by different amounts of ammonium sulfate

NUMBER OF PLANT	CONTROL				TREATMENT I			
	Replication				Replication			
	1	2	3	4	1	2	3	4
1	218	206	236	200	282	278	269	250
2	232	228	228	191	277	264	217	246
3	241	236	218	169	290	249	230	326
4	234	241	212	185	269	259	217	210
5	236	262	230	212	278	280	240	250
6	249	212	186	210	280	276	258	191
7	255	219	264	169	260	266	242	338
8	260	226	203	178	272	270	256	242
9	265	229	228	180	290	277	251	240
10	241	216	236	221	298	282	255	224
11	219	236	234	169	300	290	238	316
12	249	218	239	174	289	264	206	200
13	250	242	196	178	285	286	219	243
14	261	248	216	153	265	283	215	247
15	224	256	226	184	283	269	249	231
16	260	249	234	176	256	289	266	227
17	267	233	236	170	284	292	260	248
18	258	242	219	200	276	239	253	207
19	247	264	238	197	273	241	222	218
20	263	244		198	268	274	242	230
Total	4929	4707	4501	3714	5575	5428	4805	4884
Replication mean	246.45	235.35	225.05	185.70	278.75	271.40	240.25	244.20
Treatment mean				223.13				258.65

TABLE 2 (continued)

NUMBER OF PLANT	TREATMENT II				TREATMENT III			
	Replication				Replication			
	1	2	3	4	1	2	3	4
1	312	300	248	282	323	330	376	386
2	283	294	316	308	330	290	366	384
3	290	286	309	271	322	318	318	315
4	320	312	321	279	296	346	361	346
5	305	276	329	283	312	341	348	358
6	298	278	283	254	337	334	286	290
7	289	312	331	260	340	348	296	306
8	284	256	269	300	288	287	278	314
9	279	269	290	262	294	300	315	300
10	286	260	289	287	312	296	350	368
11	315	288	314	326	318	270	338	388
12	308	273	340	340	300	340	369	357
13	310	280	296	296	286	359	370	359
14	284	258	290	278	289	292	347	360
15	314	285	356	269	308	284	363	381
16	311	321	286	270	276	276	308	378
17	318	290	300	249	278	297	360	387
18	297	329	361	333	311	300	374	308
19	306	331	301	254	284	311	381	364
20	300	340	290	297	282	306	388	346
Total	6009	5838	6119	5698	6086	6225	6892	6995
Replication mean	300.45	291.90	305.95	284.90	304.30	311.25	344.60	349.75
Treatment mean				295.80				327.47

TABLE 2 (continued)

REPLICATION	TREATMENT				TOTAL	MEAN
	1	2	3	4		
I	4,929	5,575	6,009	6,086	22,599	5,649.75
II	4,707	5,428	5,838	6,225	22,198	5,549.50
III	4,501	4,805	6,119	6,892	22,317	5,579.25
IV	3,714	4,884	5,698	6,995	21,291	5,322.75
Total	17,851	20,692	23,664	26,198	88,405	
Mean	4,462.75	5,173.00	5,916.00	6,549.50		

Analysis of variance

SOURCE OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Replication	3	12,283.28	4,094.43			
Treatment	3	491,233.18	163,744.39	16.71	3.86	6.99
Replication × Treatment	9	88,195.97	9,799.49			
Sampling error	304	1,093,869.25	3,598.19			
Total	319	1,685,581.68				

L.S.M.D. = 35.41

TABLE 3

Yield of dry fiber in grams as influenced by different amounts of ammonium sulfate fertilizer

REPLICATION	TREATMENT				TOTAL	MEAN
	1	2	3	4		
I	134	179	317	234	864	216.00
II	121	134	266	410	931	232.75
III	115	167	353	539	1174	293.50
IV	114	138	317	531	1130	282.50
Total	514	618	1253	1714	4099	
Mean	128.50	154.50	313.25	428.50		

Analysis of variance

SOURCE OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Block	3	17,029.44	5,676.48			
Treatment	3	238,407.44	79,468.15	14.40	3.86	6.99
Block × Treatment	9	496,583.10	5,517.59			
Total	15	305,095.18				

L.S.M.D. = 118.81

TABLE 4

Yield of capsules as influenced by different amounts of ammonium sulfate fertilizer

REPLICATION	TREATMENT				TOTAL	MEAN
	1	2	3	4		
I	308	328	357	475	1,468	367.00
II	236	285	410	378	1,309	327.25
III	222	365	384	454	1,425	356.25
IV	186	227	292	466	1,171	292.75
Total	952	1,205	1,443	1,773	5,373	
Mean	238	301.25	360.75	443.25		

Analysis of variance

SOURCE OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Block	3	13,272.19	4,424.06			
Treatment	3	91,706.19	30,568.73	14.6698	3.86	6.99
Block × Treatment	9	18,754.06	2,083.78			
Total	15	123,732.44				

L.S.M.D. = 52.08

TABLE 5

Yield of seeds to a plant as influenced by different amounts of ammonium sulfate fertilizer

REPLICATION	TREATMENT				TOTAL	MEAN
	1	2	3	4		
I	246.6	272.0	273.2	388.1	1,179.9	294.97
II	165.8	208.4	351.9	310.6	1,036.7	259.17
III	153.0	289.5	310.2	353.2	1,105.9	276.48
IV	138.7	147.0	186.4	335.7	807.8	201.95
Total	704.1	916.9	1,121.7	1,387.6	4,130.3	
Mean	176.0	229.2	280.4	346.9		

Analysis of variance

SOURCE OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Block	3	19,405.51	6,468.44			
Treatment	3	63,791.55	21,263.57	10.43	3.86	6.99
Block × Treatment	9	18,353.06	2,039.23			
Total	15	101,550.12				

L.S.M.D. = 72.23

TABLE 6

Tensile strength of kenaf fiber as influenced by different amounts of ammonium sulfate fertilizer

REPLICATION	TREATMENT				TOTAL	MEAN
	1	2	3	4		
I	24.75	22.22	26.15	29.70	102.82	25.70
II	23.62	19.46	24.77	34.01	101.86	25.46
III	19.37	26.10	31.01	32.54	109.02	27.25
IV	21.54	24.43	30.82	32.16	108.95	27.24
Total	98.28	92.21	112.75	128.41	422.65	
Mean	22.32	23.05	28.19	32.10		

Analysis of variance

SOURCE OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Block	3	11.1548	3.7182			
Treatment	3	254.2594	84.7531	10.7635	3.86	6.99
Block × Treatment	9	70.8674	7.8741			
Total	15	336.2816				

L.S.M.D. = 4.48

THE DIGESTIBILITY OF WATER HYACINTH (EICHHORNIA CRASSIPES) SILAGE BY SHEEP [1]

J. K. Loosli, R. P. Belmonte, Valente Villegas, and Epifania Cruz [2]

Water hyacinth (*Eichhornia crassipes* [Mart.] Solms.) silage was palatable to sheep, but 18 digestion experiments showed it to contain an average of only 0.4 per cent digestible protein and 4.7 per cent total digestible nutrients. The silage averaged 90.0 per cent water, which explains its low nutritive value.

The fresh leaves of water hyacinth (*Eichhornia crassipes* [Mart.] Solmns.) are eaten by carabaos especially when other feeds are scarce. Agrupis [3] reported that fresh water hyacinth was unpalatable to Red Sindhi cows, but when made into silage, it was readily eaten.

Digestion experiments were carried out to determine the nutritive value of water hyacinth silage to sheep.

EXPERIMENTAL METHODS

The equipment and techniques employed were the same as those described by Loosli, Villegas, Garcia, and Ynalvez.[4] The water hyacinth silage was prepared by dipping the chopped leaves and stems into a solution of one part of molasses and four parts of water. The excess liquid was drained off and the water hyacinth placed in a pit silo, weighted down, and covered to insure minimum spoilage.

During the digestion experiments fresh silage was taken from the silo for the two daily feedings of six sheep. The amount of feed given approximated all of the silage that they could eat regularly. Only in a few instances were small quantities of silage left uneaten. These orts were dried and analyzed so that the actual intakes could be determined. The silage was the only feed given in one series. In the next two series corn gluten feed, molasses, and a concentrate mixture were fed in addition to the silage.

RESULTS AND DISCUSSION

The chemical analyses of the feeds are shown in table 1.

The average digestion coefficients for all nutrients were higher in the ration containing concentrates than in the water hyacinth

[1] Central Experiment Station Contribution No. 1771. Part of the data were taken from a thesis submitted by R. P. Belmonte for graduation with the degree of Bachelor of Science in Agriculture, College of Agriculture, 1954.

[2] The authors acknowledge the assistance of L. A. Ynalvez and Lolita Austria in making the chemical analyses and of S. E. Claud in caring for the experimental animals.

[3] F. M. Agrupis, *Philippine Agriculturist*, 37, 50 (1953).

[4] J. K. Loosli, V. Villegas, G. V. Garcia, and L. A. Ynalvez, *Philippine Agriculturist*, 38,— (1954).

silage alone (table 2). This is to be expected since most concentrates are more completely digested than roughages.

The digestion coefficients of the silage were calculated in series II and III by the difference method using the coefficients of Morrison [5] to correct for the influence of the concentrates. The mean values in series II and III, particularly for protein, showed wide variability. The reason for this is not obvious, but it is known that calculations by the difference method often give much greater variability in results than direct determinations because of the interaction among feeds, cumulative errors, and related factors. The averages of series II and III were relatively similar to the coefficients of series I. The digestible protein and total digestible nutrient (T.D.N.) content of the silage were calculated by using the coefficients for the three series. In series I the water hyacinth silage contained 0.28 per cent of digestible protein and 2.78 per cent of T.D.N. In series II the values were 0.79 per cent for protein and 6.16 per cent for T.D.N., and in series III, 0.27 per cent for protein and 5.11 per cent for T.D.N. The calculated values tended to be higher when a concentrate was fed along with the silage than when the silage was given alone.

The results are not as uniform as the authors would have wanted to obtain. All the estimates, however, show that water hyacinth silage is low in feeding value, primarily because of its very high water content. On a dry basis the silage appears fairly nutritious. The sheep were unable to eat a sufficient amount of the silage to maintain their weights unless a concentrate was also fed. In an earlier study it was found that flint corn silage contained 0.3 per cent digestible protein and 16.1 per cent T.D.N., and four samples of Para grass contained an average of 1.7 per cent protein and 10.9 per cent T.D.N.

On account of the low feeding value of water hyacinth silage, preparing it does not seem worthwhile, unless other feeds are scarce or very expensive. Of course, water hyacinth silage can be greatly improved in value by adding to it during ensiling nutritive feeds such as undiluted molasses, copra meal, and rice bran, but fermentation losses may be too great to make this procedure economically advisable. Perhaps a mixture of rice straw and water hyacinth would make a silage suitable for maintaining cattle or carabaos during periods of feed shortage.

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[5] F. B. Morrison, "Feeds and Feeding," Morrison Publishing Co., Ithaca, N. Y., 1951.

TABLE 1

Chemical analyses of the feeds

FEED	MOISTURE	PROTEIN	FAT	FIBER	N.F.E.	ASH
	per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
Concentrate [a]	16.90	9.89	3.37	4.79	58.90	6.15
Corn gluten feed plus molasses [b]	11.88	18.51	3.00	6.79	56.04	3.78
Water hyacinth	92.22	1.00	0.26	1.92	3.67	0.93
Water hyacinth silage	93.73	0.84	0.17	1.34	2.65	1.27
" " "	88.24	1.12	0.14	2.21	6.31	1.98
" " "	87.63	1.05	0.14	2.46	6.21	2.51

[a] Contained 25 per cent flint corn, 25 per cent rice bran, 25 per cent copra meal, 23 per cent cane molasses, 1 per cent shells, and 1 per cent salt.
[b] Contained 83 per cent corn gluten, 15 per cent molasses, 1 per cent shells, and 1 per cent salt.

TABLE 2

Digestion coefficients of the three rations studied

EXPERIMENT AND RATION	ANIMAL NO.	DIGESTION COEFFICIENTS				
		Organic matter	Crude protein	Ether extract	Crude fiber	N.F.E.
	43	54.5	45.0	52.8	66.0	53.6
	45	59.8	30.1	47.1	56.6	66.4
I Water hyacinth	191	49.5	31.1	63.2	43.3	54.7
silage alone	194	51.8	27.3	54.6	50.2	56.6
	197	59.8	39.4	49.1	52.3	66.3
	226	53.7	25.7	44.2	49.4	60.4
Mean ± S.E.		54.8	33.1	51.8	53.0	59.7
		1.72	3.04	2.74	3.10	2.31
	43	66.2	43.6	67.1	43.9	74.6
	45	68.1	47.6	70.9	54.3	74.7
II Water hyacinth	190	77.5	64.7	84.8	67.5	81.7
silage plus	191	74.1	59.5	78.9	59.2	79.3
concentrate	194	76.2	60.9	78.7	63.0	81.5
	197	73.2	60.1	77.0	54.6	79.0
Mean ± S.E.		72.6	56.1	76.2	57.1	78.5
		1.8	3.28	3.50	3.23	1.29
	43	66.4	57.7	61.9	61.3	69.7
	45	70.7	66.1	82.1	65.1	73.4
III Water hyacinth	191	59.2	39.1	58.0	53.6	65.7
silage plus	194	73.9	65.3	79.7	70.9	76.7
gluten feed	197	60.5	37.9	61.2	50.5	65.9
	226	71.7	64.9	70.9	63.9	75.7
Mean ± S.E.		67.1	55.2	69.0	60.9	71.2
II Silage alone [a]		2.49	1.68	4.17	3.09	1.70
III Silage alone [a]		—	70.5	33.6	58.3	63.2
		—	25.4	47.1	55.1	53.7
Mean			47.9	40.4	56.7	58.5

[a] Calculated by difference.

AN EVALUATION OF THE RELATIVE ACCURACY OF TWO METHODS OF SAMPLING FOR SOIL MOISTURE [1]

AMADOR D. YÑIGUEZ

Estimates of the mean gain in efficiency of stratified random sampling over unrestricted sampling were 86.43 per cent by Cochran's derivation and 161.91 per cent by direct estimates. Stratification required considerably less samples from which to estimate a plot mean to attain a given degree of precision. It is recommended that stratification be employed in the sampling of soils, even if the samplings are carried on in small experimental plots. For soil moisture, about forty-six borings should be located by some stratified random scheme so that the standard error will be about ten per cent of the plot mean.

Each season, many field experiments are conducted to study the effect of cultural and management practices, such as the use of fertilizers, methods of plowing and cultivation, and distance and rate of seeding, on plant growth and on the chemical and physical properties of soils. The plots used in these experiments are usually laid out in the field without due regard to trends in soil fertility. To increase the efficiency of blocking, say, in a randomized block experiment, the plots in the block must be as homogeneous as possible. Proper and accurate methods of sampling must be used to evaluate the homogeneity of the plots in a block.

Methods of soil sampling must first be evaluated as to their relative accuracy before they can be recommended. This investigation is the first of a series of studies on soil sampling. Estimates of the relative efficiency of stratified random sampling over unrestricted random sampling for soil moisture are given, as well as estimates of the size of sample necessary for each method to achieve a certain given degree of precision in the sampling of experimental plots.

The study was conducted from November, 1952, to February, 1954, in three experimental fields of the Central Experiment Station, in the statistical laboratory, Department of Agricultural Engineering, and in the laboratory of the Department of Soils, College of Agriculture, Los Baños, Laguna.

Considerable literature exists on the subject of soil sampling. As early as 1915, Robinson and Lloyd estimated the probable field error of various soil properties of two large fields.

Youden and Mehlich (1937), Rigney and Reed (1945), and Reed and Rigney (1947) investigated the variations of the chemical and physical properties of soils from large areas of fields. These authors

[1] Central Experiment Station Contribution No. 1772. Thesis presented for graduation, April, 1954, with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Agricultural Engineering under the direction of Assistant Professor Burton T. Oñate.

utilized the analysis of variance technique to study the efficiency of one sampling scheme over another.

Cline in 1944 presented some principles used in soil sampling and in 1945 described the methods of collecting and preparing soil samples for analysis. He suggested the stratification of the area under investigation into homogeneous strata in order to reduce the sampling error.

Oñate [2] obtained an estimate of 13 per cent gain in efficiency from stratification for soil moisture in experimental plots. He also presented some of the statistical aspects of the use of composites in soil sampling.

MATERIALS AND METHODS

Sampling areas. Three experimental fields in the Central Experiment Station were used as sampling areas. Sampling tubes with a radius of 0.75 of an inch were used to obtain the soil samples. The fields are described below:

FIELD NUMBER	TYPE OF EXPERIMENT	PLANT	NUMBER OF PLOTS	AREA OF EACH PLOT	TOTAL AREA
				sq. m.	*sq. m.*
I	Fertilizer test	Corn	24	48	1152
II	Influence of irrigation on dry-season crop	Corn	20	80	1600
III	Field plot	Corn	20	64	1280

Unrestricted random sampling. In each experimental field, eight random borings were located on each plot by using the coordinate system. To obtain samples of almost constant weight, all borings were made 6 inches deep. Each boring was kept in a separate can for weighing and for transportation to the laboratory.

Stratified random sampling. In the same experimental fields, each plot was divided into four equal strata. From each stratum, two random borings were located also by the coordinate system. Each boring, as in the unrestricted random sampling, was kept in a separate can. Pacing was employed to locate each random boring in the field.

In both methods of soil sampling, the moist samples were weighed in the field to minimize the error of measurement. The weighed samples were transported to the laboratory, air-dried for 24 hours, and oven-dried for six hours. After oven-drying, the percentage of moisture of every boring was determined.

[2] B. T. Oñate, "Methods for Sampling Soil from Replicated Field Experiments." (Thesis presented for graduation with the degree of Master of Science, 1952. Unpublished.)

THEORETICAL CONSIDERATIONS

The size of the plots in the three experimental fields ranged from 48 to 80 square meters. With a given depth of 6 inches, each individual boring obtained by a sampling tube with a radius of 0.75 of an inch has a surface area of approximately 1.8 square inches. If the size of the plot is 48 square meters, there will be about 41,333 individual borings in a plot. Even if 10 borings are located on each plot, the sampling rate will be only 0.00024. Thus, in the estimation of variances for the two methods of sampling in the plots, the finite corrections were not used and an infinite population was assumed.

With the appropriate additive models, the generalized analyses of variance employed on a sample (boring) basis were as follows:

(1) Unrestricted random sampling

Analysis of variance

S.V.	D.F.	M.S.	E.M.S.
Plots	$(p-1)$	P	$\sigma^2_s + s\sigma^2_p$
Samples within plots	$p(s-1)$	S	σ^2_s
Total	$ps-1$		

where
p = number of plots
s = number of borings to a plot.

(2) Stratified random sampling

Analysis of variance

S.V.	D.F.	M.S.	E.M.S.
Plots	$(p-1)$	P	$\sigma^2_s + ms\sigma^2_p$
Strata within plots	$p(m-1)$	B	$\sigma^2_s + s\sigma^2_m$
Samples within strata	$pm(s-1)$	S	σ^2_s
Total	$pms-1$		

where
p = number of plots
m = number of strata to a plot
s = number of borings to a stratum.

The relative efficiency of stratified random sampling over unrestricted random sampling was estimated by the use of the above analyses of variance. Cochran [3] concluded that the technique of stratification generally results in a smaller variance of the estimated mean than is given by a comparable unrestricted random sampling.

[3] W. C. Cochran, "Sample Survey Techniques." (Statistical report, North Carolina State College, 1948. Unpublished.)

Two methods of estimating this gain in efficiency were used. One was by using actual estimates from the two analyses of variance and the other was by using the following estimated variances by Cochran:

$$V(x,\ \text{stratified}) = \frac{S}{ms}$$

$$V(x,\ \text{random}) = \left\{\frac{(m-1)B + [m(s-1)+1]S}{(m-1) + m(s-1) + 1}\right\}\frac{1}{ms}$$

$$= \frac{(m-1)B + [m(s-1)+1]S}{(ms)^2}$$

The relative efficiency of stratified random over unrestricted random sampling was as follows:

$$\frac{V(\bar{X},\ \text{random})}{V(\bar{x},\ \text{stratified})} \times 100\% = \frac{(m-1)B + [m(s-1)+1]S}{(ms)S} \times 100\%$$

where

B and S were obtained from analysis of variance (2)

and

m = number of strata to a plot
s = number of borings to a stratum.

Estimates of the number of individual borings necessary to give a certain degree of precision to the estimation of a plot mean were obtained from the relationships given below.

Let the standard error (s_x) be of a given percentage of the plot mean (X), that is,

$$\frac{sx}{x} = \text{percentage or fraction of the plot mean (level of precision)} \qquad \text{(a)}$$

where

$$s_{\bar{x}} = \frac{s}{\sqrt{n}}. \qquad \text{(b)}$$

Substituting this value of s_x in (a), we obtain for n the equation

$$n = \frac{s^2}{x^2(\text{precision})^2}.$$

Pooled estimates of the variances were employed in the computation for the sizes of individual borings for unrestricted random (without stratification) and stratified random samples. In the same manner, the value of x, the plot mean, was the pooled estimate for the three separate experiments.

EXPERIMENTAL RESULTS AND DISCUSSION

To obtain a valid estimate of error, the sampling units were chosen at random.[4] With randomization, valid estimates of the sampling error were obtained by the technique of the analysis of variance. In this sampling study, the main interest was to obtain estimates B (strata within plots) and S (sampling error). The analysis for whole plots was computed by pooling the corresponding degrees of freedom and sums of squares as shown in the analyses of variance (1) and (2).

The percentage of gain in efficiency of the stratified random over that of the unrestricted random sampling computed by Cochran's equation is shown in table 4a. From table 1b of experiment 1,

$$V(\bar{x}, \text{ stratified}) = \frac{35.64}{(4)(2)} = \frac{35.64}{8} = 4.45$$

$$V(\bar{x}, \text{ random}) = \frac{(4-1)102.14 + [4(2-1)+1]35.64}{(4)(2)^2} = \frac{(3)102.14 + (5)35.64}{64} = \frac{484.62}{64} = 7.57.$$

The relative efficiency of stratified random over unrestricted random sampling was

$$\frac{V(\bar{x}, \text{ random})}{V(\bar{x}, \text{ stratified})} \times 100\% = \frac{7.57}{4.45} \times 100\% = 170.11\%$$

or a gain of 70.11 per cent.

Similarly, when the estimates of B and S (table 2b) of experiment 2 were used, the gain in efficiency was 33.14 per cent; when the estimates of B and S (table 3b) of experiment 3 were used, the gain in efficiency was 156.06 per cent. The mean gain of 86.43 per cent is shown in table 4a.

Direct estimates of S were utilized from the corresponding analyses of variance for unrestricted and stratified random samples. In experiment 1, the sampling error (samples within plots) for the

[4] The original data of this sampling study are on file in the Department of Agricultural Engineering.

unrestricted random sample was 55.36 (table 1a), and that for the stratified sample was 35.64 (table 1b). These would give the following variances of the plot mean:

$$V(\bar{x}, \text{ random}) = \frac{55.36}{8} = 6.92$$

and

$$V(\bar{x}, \text{ stratified}) = \frac{35.64}{8} = 4.45$$

as in table 4a.

The gain in efficiency was

$$\frac{6.92}{4.45} \times 100\% = 155.51\%$$

or a gain of 55.51 per cent. Estimates for experiments 2 and 3 were obtained in a similar manner. The gain for experiment 2 was 121.14 and for experiment 3, 309.09 per cent. In table 4b is shown the percentage of gain in efficiency obtained by direct estimates from the analyses of variance. The mean gain was 161.91 per cent.

These two estimates of the mean gain in efficiency imply that from 86 to as much as 162 per cent more information may be obtained from the mean of a stratified sample than from the mean of a comparable unrestricted random sample. The practical implication of these results may be seen by a study of the estimates shown in table 5. Considerable variations for soil moisture may be noted in each small experimental plot. Stratification can reduce these variations to a large degree. Also, no additional amount of labor is necessary in stratification. In fact, dividing the plot into strata simplifies the actual sampling of the experimental fields.

Estimates of the number of individual samples required to give a certain degree of precision to the estimation of a plot mean are shown in table 5. These estimates were obtained from the relation

$$n = \frac{s^2}{\bar{x}^2 (\text{precision})^2}$$

where

n = size of sample needed at a given degree of precision
s^2 = pooled variance for the unstratified and the stratified sample, respectively
x = pooled estimate of the mean for the combined three experiments

and the precision is given as a percentage of the plot mean.

Thus, from tables 1b, 2b, and 3b,

$$s^2(\text{without stratification}) = \frac{(102.14)72 + (35.64)96 + (26.31)60 + (14.06)80 + (27.40)60 + (5.27)80}{72 + 96 + 60 + 80 + 60 + 80}$$

$$= \frac{15{,}544.91}{488}$$

$$= 34.69.$$

Similarly,

$$s^2(\text{with stratification}) = \frac{(35.64)96 + (14.06)80 + (5.27)80}{96 + 80 + 80}$$

$$= \frac{4{,}968.16}{256}$$

$$= 19.41.$$

The pooled estimate for x was 28.36 per cent.

For the standard error (s_x) to be 10 per cent of the plot mean (x), the size of sample without stratification should have been

$$n = \frac{(34.69)^2}{(28.36)^2(.10)^2}$$

$$= 149$$

and for the stratified sample,

$$n = \frac{(19.41)^2}{(28.36)^2(.10)^2}$$

$$= 46.$$

The reduction in the size or number of individual borings at a given degree of precision is considerable with the use of stratification. Of course, the estimation procedure is simple since only one soil characteristic is involved. If several characteristics are being studied, the characteristic with the highest sampling error will determine the size of sample necessary to give a desired precision. This discussion is based on the theory of random sampling.

The means and ranges of percentage of moisture of the three experiments are shown in table 6. This table may be of help from the standpoint of practical soils work. The reduction of the sampling error due to stratification will enable the research worker to detect small differences in testing hypotheses.

More data are being gathered on the variability of other chemical and physical properties of soils from large areas. Included in these studies is the problem of the use of composites in the proper and accurate sampling of soils from larger fields.

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TABLE 1a

Analysis of variance of unrestricted random sample (experiment 1)

S.V.	D.F.	S.S.	M.S.
Plots	23	2,765.30	120.23
Samples within plots	168	9,299.64	55.36
Total	191	12,064.94	

TABLE 1b

Analysis of variance of stratified random sample (experiment 1)

S.V.	D.F.	S.S.	M.S.
Plots	23	2,497.58	108.59
Strata within plots	72	7,353.78	102.14
Samples within strata	96	3,421.19	35.64
Total	191	13,272.55	

TABLE 2a

Analysis of variance of unrestricted random sample (experiment 2)

S.V.	D.F.	S.S.	M.S.
Plots	19	601.59	31.66
Samples within plots	140	4,341.43	31.01
Total	159	4,943.02	

TABLE 2b

Analysis of variance of stratified random sample (experiment 2)

S.V.	D.F.	S.S.	M.S.
Plots	19	1,478.30	77.80
Strata within plots	60	1,578.85	26.31
Samples within strata	80	1,125.03	14.06
Total	159	4,182.18	

TABLE 3a

Analysis of variance of unrestricted random sample (experiment 3)

S.V.	D.F.	S.S.	M.S.
Plots	19	2,389.26	125.75
Samples within plots	140	3,025.88	21.61
Total	159	5,415.14	

TABLE 3b

Analysis of variance of stratified random sample (experiment 3)

S.V.	D.F.	S.S.	M.S.
Plots	19	749.75	39.46
Strata within plots	60	1,644.12	27.40
Samples within strata	80	421.94	5.27
Total	159	2,815.81	

TABLE 4a

Percentage of gain in efficiency computed by Cochran's derivation

EXPERIMENT	ESTIMATE			PERCENTAGE GAIN
	$V(x,$ random$)$	$V(x,$ stratified$)$	$\frac{V(x,\text{ random})}{V(x,\text{ stratified})} \times 100$	
1	7.57	4.45	170.11	70.11
2	2.33	1.75	133.14	33.14
3	1.69	0.66	256.06	156.06
Total				259.31
Mean gain				86.43

TABLE 4b

Percentage of gain in efficiency by direct estimates from the analysis of variance

EXPERIMENT	ESTIMATE			PERCENTAGE GAIN
	$V(x,$ random$)$	$V(x,$ stratified$)$	$\frac{V(x,\text{ random})}{V(x,\text{ stratified})} \times 100$	
1	6.92	4.45	155.51	55.51
2	3.87	1.75	221.14	121.14
3	2.70	0.66	409.09	309.09
Total				485.74
Mean gain				161.91

TABLE 5

Estimates of the number of individual samples required to give a certain degree of precision to the estimation of plot mean

DEGREE OF PRECISION	NUMBER OF INDIVIDUAL SAMPLES	
Percentage of plot mean	Without stratification (unrestricted random)	With stratification
1	14,962	4,684
2	3,740	1,171
3	1,662	520
4	935	292
5	598	187
6	415	130
7	305	95
8	233	73
9	184	57
10	149	46
11	123	38
12	103	32
13	88	27
14	76	23
15	66	20
20	37	11
30	16	5
40	9	2

TABLE 6

Means and ranges of percentage of moisture of the three experiments

EXPERIMENT NUMBER	UNRESTRICTED RANDOM		STRATIFIED RANDOM	
	Mean	Range	Mean	Range
1	27.8	10.9–49.2	27.8	14.5–54.7
2	23.4	11.8–48.1	23.5	12.7–48.0
3	33.4	17.5–50.2	33.2	21.2–45.5

THE LIVING CONDITIONS OF 101 MEN STUDENTS IN THE UP COLLEGE OF AGRICULTURE, 1953-54 [1]

L. S. Robertson [2] and O. J. Sacay

The students of the UP College of Agriculture live in different places inside and outside the campus. In 1954 information regarding living conditions was obtained from 101 students chosen to be a cross section of the men student body. The sample was selected by first estimating the number of men students living in the College dormitory, private dormitories, rented private houses, bungalows, rented rooms in private houses, and a miscellaneous group composed of cabins, the YMCA, and other living places not falling under the first five groups. Then the number 100 was divided in the same proportion, and the first students contacted in each of the groups were interviewed until the specified number was reached.

The main source of support of the 101 students was their families. Only two worked regularly to supplement the money received from that source.

LIVING PLACES

The distribution of the 101 men students according to living place is shown in table A.

TABLE A

Class	Living place						
	College dorm.	Private dorm.	Rented private house [a]	Bungalow	Rented room in private house	Others	Total
Freshmen	11	9	3	2	1	4	30
Sophomores		13	1	1	1	5	21
Juniors		16	4			5	25
Seniors		12	4	3	3	3	25
All students	11	50	12	6	5	17	101

[a] The sample probably was underweighed in rented private houses.

Freshmen or newcomers are required to stay in the College dormitory until its accommodations for slightly over 200 are filled. Late newcomers are then told to find other places. At the end of the academic year these College dormitory occupants, having become acquainted with conditions in the College, are requested to transfer to other living places to make room for the incoming group of freshmen.

[1] Central Experiment Station Contribution No. 1773. Based on a study made by students in agricultural economic statistics in the second semester of 1953-54.

[2] Visiting professor of agricultural economics under the Cornell-Los Baños contract.

The private dormitories, located just outside the College, are owned either by professors of the College or by other residents of Los Baños. The private dormitories accommodated about one-half of the 101 students.

LIVING CONDITIONS

A previous study of student expenditures showed that the College dormitory was the most expensive place in which to live. The cottages, which fall under the miscellaneous group, were the least expensive. Private dormitories, bungalows, and others ranked between these extremes.[3]

The size and description of the rooms occupied by the 101 students are given in table B.

TABLE B

ITEM	LIVING PLACE						
	College dorm.	Private dorm.	Rented private house	Bungalow	Rented room in private house	Others	Average
Persons in room	5.7	2.6	3.0	3.0	4.4	3.8	3.1
Size of room (m.):							
Length	8.9	4.6	4.2	3.5	6.7	5.0	5.1
Width	6.0	3.8	3.7	3.3	4.5	3.9	4.1
Height	5.0	3.9	3.5	3.2	3.9	3.9	3.9
Area (sq. m.):							
Total	53.4	18.7	16.1	12.2	31.1	20.2	22.7
To a person	9.3	7.8	16.1	4.8	11.0	7.4	8.9
Volume (cu. m.):							
Total	267.5	80.8	65.2	40.7	114.4	82.2	98.8
To a person	46.7	31.2	24.4	16.4	25.1	30.7	30.8
Windows:							
Number	8.2	2.3	2.4	2.0	1.2	2.5	2.9
Total area (sq. m.)	26.6	5.8	6.4	12.2	5.3	5.5	8.4
To a person	4.7	2.5	2.2	4.4	1.1	2.3	2.7
Floor material (%):							
Bamboo						18	3
Board	100	49	83	100	100	47	64
Concrete		51	17			35	33
Screening (%):							
Well screened		2					1
Poorly screened		6					3
Not screened	100	92	100	100	100	100	96
Lock to room (%)	100	90	92	100	60	59	85

In general the averages in the table comply with the standards set up by health authorities.[4] Only four students had rooms with below-

[3] L. S. Robertson and N. B. Tablante, "Expenditures of 117 Men Students in the College of Agriculture, UP, 1952–53." (Paper read at the 222nd scientific meeting of the Los Baños Biological Club.)

[4] According to the U. S. Local Government Board, a common lodging house should have a minimum of 300 to 500 cubic feet of space (8.5-14 cubic meters). According to Harington, when the allowance is 500 cubic feet to each inhabitant, the floor space should be 42 square feet (3.9 square meters) and the height of the room should at least be 9 feet (2.7 meters).

standard cubic capacity to a person and three had ceilings below recommended height, but 11 had less floor space to a person than is considered desirable.

The size of the College dormitory rooms was more than twice the average of all the rented rooms. However, each room had about six students, which was nearly twice the average number found in all the other rooms.

Almost two-thirds of all the living places had broad floors, a third had concrete floors, and a very small proportion had bamboo floors. Only one of the 101 students lived in an adequately screened room. About six-sevenths of all the rooms were provided with locks.

The facilities available in the living places of the students are given in table C. All the rooms had electric lights usually hanging from the ceiling. The main source of water was the College system. Water had to be carried to the house in water containers in only about one-fourth of the cases and was piped directly to the student's room in nearly one-half of the cases. For only one-half of the students was waste disposed of through a sewage system; for others the waste was drained out on the surface or thrown out. Eighty-four per cent of the 101 students had flush toilets; the others used pit toilets.

TABLE C

FACILITY	LIVING PLACE						
	College dorm.	Private dorm.	Rented private house	Bungalow	Rented room in private house	Others	Average
	per cent[a]						
Electric light	100	100	100	100	100	100	100
Position of light:							
Ceiling		44		33	80	71	40
Hanging	100	34	100	67	20	29	59
Desk		2					1
Water source:							
College	100	100	100	100	100	88	98
Rain		2				6	2
Other		2				6	2
Water received:							
Carried		10	33	17	20	47	20
Piped to room	100	43	25	83		18	43
Piped to same floor			33		20	29	10
Piped to other floor		47	9		60	6	27
Waste disposal:							
Sewage	100	39	62	100	80	18	50
Drain surface		55	38			82	86
Thrown out		6			20		4
Toilet facilities:							
Flush	100	90	83	100	100	47	84
Pit		10	17			53	16

[a] A few items add up to more than 100% because some students reported more than one condition.

The furniture in the living quarters of most of the students consisted of beds, study tables, and chairs (table D). The spring type of bed was the most common. Only four beds were double deck. About half of the beds had mattresses.

TABLE D

FURNITURE	LIVING PLACE						
	College dorm.	Private dorm.	Rented private house	Bungalow	Rented room in private house	Others	Average
	per cent						
Bed:							
Cot		10	62		80	76	29
Spring	100	80	23	100	20	18	63
Rattan		10	15			6	8
Quality of bed:							
One deck	100	98	92	100	75	94	96
Two decks		2	8		25	6	4
With mattress	100	29	17	100	50	76	48
Without mattress		71	83		50	23	52
Chair:							
Straight back	100	69	33	100	80	82	72
No back		24	50			18	21
Easy		8	8				5
Radio:							
Own		2	17		20	6	5
Available in room	9	41	17	33	20	6	28
Available in house		2	25			29	9
None	91	55	41	67	60	59	58
	average size						
Study table:							
Length (cm.)	192	104	98	158	60	165	103
Width (cm.)	95	86	65	100	48	83	83
Area (sq.m.)	1.8	0.8	0.7	1.6	0.6	1.5	1.0
Area to a person	0.6	0.5	0.5	0.8	0.4	0.6	0.5
	number						
Persons using table	3.2	1.8	1.5	2.2	1.6	2.3	2.0

The average study table was small; a student used only one-half of a square meter of table surface. Almost every person was provided with a chair, the most common being the straight-back type. More than one-half of the students did not own a radio or have access to one in the room or in the house.

EATING PLACES

No attempt was made to interview students representative of the entire men student body with respect to eating place. Table E gives the eating places of the 101 students interviewed.

TABLE E

CLASS	EATING PLACE					
	Did own cooking	Mess hall	Grove	Private house	YMCA	Total
Freshmen	11	2	5	11	1	30
Sophomores	8	1	7	5		21
Juniors	10		9	4	2	25
Seniors	11		7	6	1	25
All students	40	3	28	26	4	101

The eating place was related somewhat to the living place. The three students in the sample who ate at the mess hall lived nearby in the College dormitory and the bungalows. A larger proportion of the bungalow dwellers than of the other groups ate in the Grove. The College dormitory and private dormitory groups tended to be the "cookers" although cooking was done by 18 to 25 per cent of those who lived in rented private houses, rented rooms in private houses, and miscellaneous places. None of the students living in the College dormitory or the bungalows, but from a fifth to nearly one-half of those in the other groups, boarded in private houses.

DIET

The diet of the 101 students varied according to their eating place and, probably, to their appetite and financial condition. Each student was asked to state whether his daily consumption of six different basic foods was as much as a standard amount stated to him, more than one-half of this amount, or less than one-half.[5] The questions probably were answered largely in terms of the food intake on the day previous to the interview although an attempt was made to get answers representative of the usual diet. The standards were those suggested by the Bureau of Agricultural Extension of the Department of Agriculture and Natural Resources.[6]

Those students who ate at the mess hall had well-balanced diets (table F). They reported about ninety-six per cent adequacy as an average for all of the six basic requirements. Students cooking their own food had the least efficient diets according to the standards. Their diets were particularly deficient in milk and protein-rich foods. The students eating in the Grove, in private houses, and in the YMCA each reported an average of around two-thirds adequacy for the six

[5] The assistance of Mrs. Oñate and her co-workers in the Department of Home Technology in planning this part of the survey is acknowledged.

[6] 1. Leafy green and yellow vegetables—½ cup.
2. Vitamin C-rich foods—1 serving (½ cup of salad greens, 2 medium-sized fruits, or one slice of big fruit).
3. Succulent vegetables and fruits—1 cup.
4. Milk—½ cup; other calcium-rich foods—1 generous serving.
5. Protein-rich foods—1 generous serving; eggs—½ (3 to 4 a week).
6. Rice or other energy-giving foods—3 servings (one serving is 1 cup cooked rice, 3 pieces, pan de sal, 2 slices of bread, or ½ cup of other cooked cereal).

food groups. Their diets tended to be deficient in milk, succulent vegetables, and fruits.

TABLE F

SIX BASIC FOODS	EATING PLACE					
	Did own cooking	Mess hall	Grove	Private house	YMCA	Mean
	per cent					
1. Leafy green and yellow vegetables:						
Full	75	100	89	73	50	78
One-half	15		4	19	25	13
Less than one-half	10		7	8	25	10
2. Vitamin C-rich foods:						
Full	73	100	79	61	100	73
One-half	22		18	31		22
Less than one-half	5		3	8		5
3. Succulent vegetables and fruits:						
Full	55	100	71	69	25	63
One-half	42		29	23	75	34
Less than one-half	3			8		3
4. Milk:						
Full	30	100	32	31	50	34
One-half	20		46	23		27
Less than one-half	50		22	46	50	39
Other calcium-rich foods:						
Full	45	67	57	46	50	49
One-half	50		39	50	25	45
Less than one-half	5	33	4	4	25	6
5. Protein-rich foods:						
Full	40	100	75	58	100	58
One-half	48		21	38		35
Less than one-half	12		4	4		7
Eggs:						
Full	67	100	86	77	100	77
One-half	28		14	15		19
Less than one-half	5			8		4
6. Rice or other energy-giving foods:						
Full	100	100	100	100	100	100
One-half						
Less than one-half						
Mean:						
Full	61	96	74	64	72	67
One-half	28		21	25	16	24
Less than one-half	11	4	5	11	12	9

On the average, about two-thirds of the 101 students had amounts up to the standards, about a fourth had half these amounts, and about a tenth had less than one-half. The diets generally were deficient in milk and other calcium-rich foods.

COOKING CONDITIONS

Many students who wanted to economize or to eat the kind of food they preferred cooked for themselves. They formed themselves into groups and rotated or divided the work. Each member of the group either was assigned to do all the work for a certain day or was assigned a definite work for the whole year.

The average size of the kitchens used by the "cookers" was 6 meters long, 4 meters wide, and 3.5 meters high. The average area of the kitchens was 27.7 square meters. The average number of students in a group was 3.6. The average number of individuals using a kitchen was 8.9. Gas stoves and wood-burning stoves were about equally common; electric stoves were used by 5 per cent.

Garbage was dumped in a pit by 72 per cent of the students who cooked their own food, burned by 28 per cent, and disposed of by other methods by 5 per cent. Some students used two methods.

PUBLICATIONS RECEIVED

The publications received regularly at the living quarters of 101 students are shown in table G.

TABLE G

PUBLICATION	LIVING PLACE						
	College dorm.	Private dorm.	Rented private house	Bungalow	Rented room in private house	Others	Average
	per cent						
Magazines:							
Life		6					3
Country Gentleman		6					3
Readers Digest	9	12	33			12	14
Free Press	27	6	17	33	20	12	13
Others	18	18	42			29	21
None	64	65	50	67	80	59	62
Newspapers:							
Manila Times	18	16	42			29	20
Manila Chronicle					20		1
Others		10	17		20	24	12
None	82	74	54	100	60	53	70

STUDYING AND LIVING HABITS

The studying and living habits of the 101 students varied (table H). Most of the students participated in outdoor games once or twice a week in addition to their exercises in physical education. The average number of hours of sleep conformed to the standard sleeping requirement of six to eight hours. About nine-tenths of the houses were provided with bathrooms. The College dormitory students took baths more frequently than the others. About one-fifth of the students did all of their own laundry, and another one-

fifth did part of their laundry. A little more than one-half of the 101 students smoked.

TABLE H

STUDYING OR LIVING HABIT	LIVING PLACE						
	College dorm.	Private dorm.	Rented private house	Bungalow	Rented room in private house	Others	Average
	per cent[a]						
Study period:							
School hours		4					2
Evening	82	74	67	67	40	65	71
Early morning		8	8	17	40	6	9
Irregular hours	18	18	25	33	40	35	24
Usual reading position:							
With light over shoulder	55	41	33	83	40	71	50
Sitting with light in front	27	33	33	17		12	27
Lying down	18	39	50		60	18	34
Use of mosquito net:							
Always	100	94	100	100	100	100	97
Usually		2					1
Seldom		2					1
No		2					1
Doing own laundry:							
All	36	6	8	17	20	12	20
Part	9	25	25			18	20
Smoking	45	60	33	50	80	53	54
Bathroom in house	82	94	83	100	100	88	91
	number						
Baths a week	6.0	4.4	5.3	6.8	3.8	3.7	4.7
Recreation:							
Outdoor games a week	2	1	1	1	2	1	1
Moving pictures a week	1	1	1	2	1	1	1
Trip to Manila a month	1	1	2	2	1	1	1
Average no. of hrs. sleep	6.3	7.4	8.3	6.5	7.0	7.6	7.3

[a] A few items add up to more than 100% because some students reported more than one method.

COMMON COMPLAINTS ABOUT LIVING CONDITIONS

The outstanding objection of students to their living conditions was the poor lighting system. They complained that the electric lights were very weak at night. Students also complained that occupants of the College dormitory and the private houses were very noisy. Very weak water pressure or no water at all was the complaint of some. Other objections to their living conditions were poor ventilation, poor roofing and walling materials, unsanitary toilets, no bathrooms, muddy roads, and disorderly kitchens.

THE INFLUENCE OF SEASON ON THE AMOUNT AND QUALITY OF SEMEN PRODUCED BY THE COLLEGE S. C. WHITE LEGHORN ROOSTERS [1]

PEDRO L. ALEJANDRINO

WITH FIVE TEXT FIGURES

Temperature had a stimulating influence on semen volume and concentration, as well as on initial motility. An increasing length of daylight apparently enhanced motility and fertilizing efficiency. Motility was found to be inversely related to fertilizing efficiency.

The late winter and early spring months of February, March, and April seemed to be the time when the greatest volume, as well as concentration, of semen was produced. This was also the period when sperms were at the height of their fertilizing efficiency. It may be concluded that there is a definite annual rhythm of sperm production and efficiency similar to that observed in egg production.

Many investigators have observed that egg production of the domestic fowl is markedly influenced by season and that higher egg production is correlated with increasing length of daylight. Similar findings have been reported on the effect of season on semen production. In the United States, Parker and McSpadden (1943) and Wheeler and Andrews (1943) found that the total number of sperms ejaculated by cockerels increased from December through April. The first team of workers also observed that, like egg production, semen production declined during the late spring and summer months.

As cited by Taylor (1949), Benoit, working with ducks in 1935, and Margolf, with turkeys in 1940, demonstrated that increments in daily amount of light induced marked testicular enlargement and spermatogenesis during the seasons when the reproductive organs of these two fowls are more or less quiescent. Results of studies by Lamoreux (1943) showed that the amount of light also influences sperm production in the male chicken.

In the Philippines where seasons of the year are not markedly varied, egg production tends to be lower during the rainy months of June and November. To find out if season has the same influence on sperm production as on the quality of semen produced, this study was conducted in the Department of Animal Husbandry from February 2, 1953, to January 28, 1954.

MATERIALS AND METHODS

The data analyzed in this investigation were collected from 12 yearling S. C. White Leghorn roosters confined in individual cages.

[1] Central Experiment Station Contribution No. 1774. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1954. Prepared in the Department of Animal Husbandry under the direction of Instructor Amado C. Campos.

All the birds were given the same feed and management throughout the study. Mash ration and fresh drinking water were made accessible to them at all times. In addition, chopped young ipil-ipil (*Leucaena glauca* Linn.) leaves were given them three times a week.

Records of atmospheric temperature and relative humidity during the study were obtained from the Department of Agricultural Engineering (table 1). An astronomical handbook [2] was used for determining the length of daylight.

The fertilizing efficiency of the roosters' sperms was tested by using the semen in the insemination of S. C. White Leghorn yearling layers kept in battery laying cages. Four hens were assigned to each rooster. Semen samples were collected on February 2, 1953, and weekly thereafter for one year. Since preliminary observation was that most hens lay during the earlier part of the day, the hens were inseminated in the afternoon. All normal eggs laid by the inseminated hens were identified and set in a James-way incubator at regular intervals. On the seventh day, the eggs were candled to determine their fertility.

Semen samples were collected from each rooster by the massage method described by Burrows and Quinn (1937). This method involves the stimulation of a protrusion of the bulbous papilla by massaging of the anterior lateral muscle of the abdomen. After collection, the samples were immediately judged for color and turbidity. Those contaminated with feces were discarded. The semen volume was measured in a tuberculin syringe. A portion from each semen sample was saved for microscopic study, and then the designated hens were inseminated at the rate of 0.1 milliliter to a hen.

The method followed in the insemination of hens was also that described by Burrows and Quinn.[3] This consists in exposing the vaginal opening and injecting semen directly into the uterus. Hens found to have hard-shelled eggs in their oviducts were not inseminated until after laying.

Microscopic evaluation of semen samples was made within an hour after collection. Samples of hanging drops of semen were examined under low power and scored according to the rate of movement of the sperms. No motility was given a score of 1; progressive degrees of motility were scored 2, 3, 4, and 5.

The semen concentration of the different samples was estimated with a Haden-Hauser hemocytometer in a way similar to that for counting red blood corpuscles. Semen was first diluted with a solution of 5 grams sodium bicarbonate and 1 ml. formaline (for immobilizing sperms) in 100 ml. of distilled water. After a thorough mixing of the diluted semen, a drop was placed on the counting chamber. Sperms lying at the center and in the four corners of the

[2] Prepared in 1954 under the direction of Dr. C. del Rosario, Director of the Weather Bureau.

[3] H. H. Burrows and J. P. Quinn, *USDA Cir.*, 525 (1939).

chamber were counted with the aid of a tally counter. From the number was calculated the concentration of sperms in terms of millions in a milliliter of semen.

RESULTS AND DISCUSSION

Influence of the physical factors

Semen volume. The correlation data presented in table 6 show that atmospheric temperature and relative humidity were correlated with semen yield. Temperature and semen volume had a positive correlation, whereas humidity and semen volume had a high negative correlation (fig. 1). The length of daylight was not correlated with semen volume. The value was, however, suggestive.

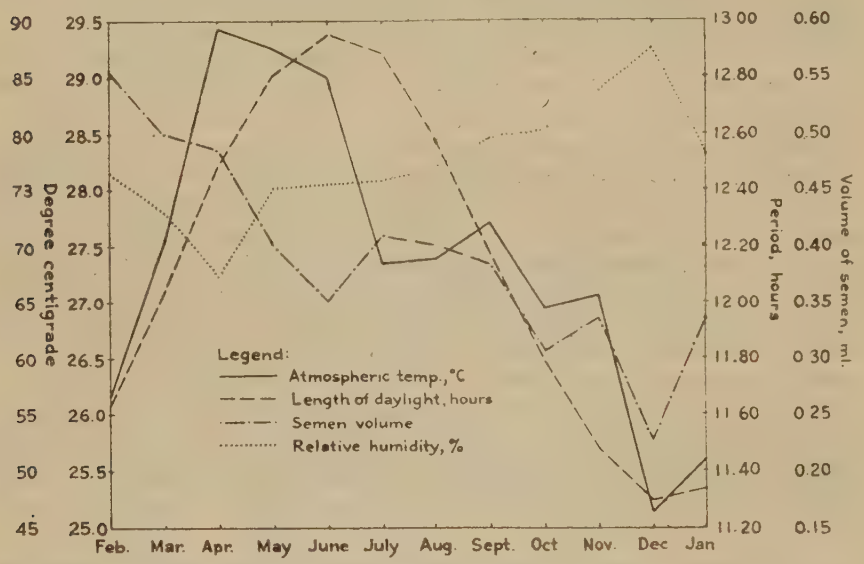

Fig. 1.—The influence of atmospheric temperature and relative humidity on semen volume.

Semen concentration. Temperature was negatively correlated with semen concentration; humidity had a higher negative correlation (table 6). These results show the depressive effect of the two factors on semen concentration. There was no correlation between length of daylight and semen concentration.

Sperm motility.[4] Statistical analysis showed that sperm motility was associated with length of daylight rather than with atmospheric temperature. The correlation between length of daylight and sperm

[4] Refers to the initial motility of sperms or degree of movement of sperms within an hour after collection.

motility was positive. On the other hand, relative humidity had a high negative correlation with sperm motility.

Fertilizing efficiency of sperms. Daylight was observed to have an important bearing on the fertilizing efficiency of sperms. Increasing length of daylight apparently had a stimulating effect.

Relation between semen characteristics and fertilizing efficiency of sperms

Correlation findings show that neither semen volume nor concentration was associated with the sperms' fertilizing efficiency. Hutt, in 1929, as cited by Taylor (1949), found no correlation between sperm concentration and the male's capacity to fertilize hens' eggs and suggested that fertility in the male depends upon the physiological efficiency of the spermatozoa rather than upon their quantity. Penquite, Craft, and Thompson in 1930, again cited by Taylor (1949), also reported that the relative number of spermatozoa in a given amount of semen had no relation to fertility.

On the other hand, sperm motility was found to be intimately associated with fertility in this study. The correlation between these two proved to be highly negative, which does not conform to the previous findings of Shaffner and Andrews (1947) that high degrees of positive correlation existed between initial motility of sperms and fertility. Lillie (1919), however, observed that the energy of the spermatozoa of mammals is saved when they are motionless and expended when they are in motion. That the sperms might have retained their fertilizing efficiency for a relatively longer time because of their inactivity may be an explanation for the result obtained in the present study.

Seasonal trends in semen characteristics

The semen volume remained at a relatively high level during the late winter and early spring months of February, March, and April, after which there was a general decline (table 2). A partial slump occurred in the beginning of summer, in June. The sharpest drop in semen volume was in December, when most of the roosters were molting.

The data in table 3 indicate the production of more sperms in a unit volume of semen during the late winter and early spring months. Semen concentration was at its peak in February; thereafter, it tended to decrease gradually till May. Concentration remained at relatively lower levels during the rest of the months.

Figures 1 and 2 present the seasonal production of sperms. An egg production curve reported by Fronda (1927) with White Leghorn layers is plotted with the distribution of sperm production in figure 3. The slump in sperm production in December may be attributed to the delayed molting among roosters in late fall and early winter. These observations all indicate that the reproductive activity of the domestic fowl is subject to an annual cycle.

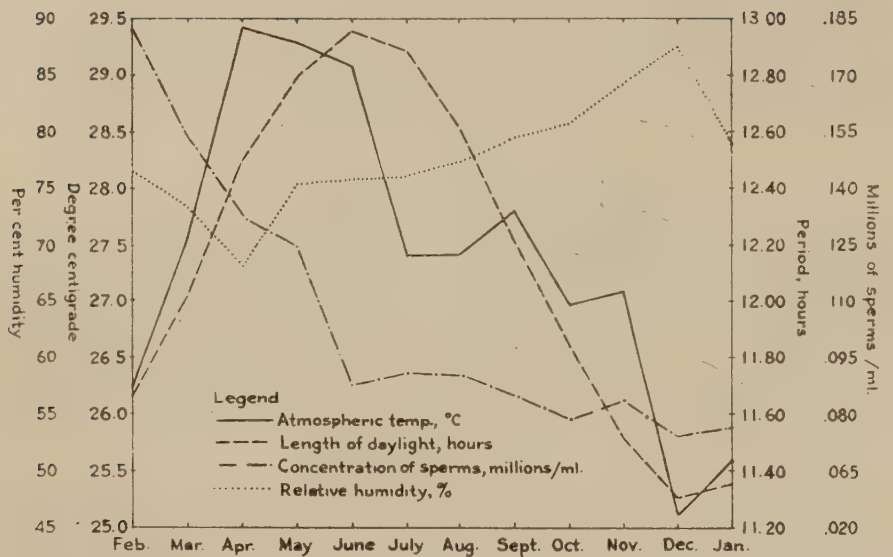

Fig. 2.—The seasonal production of sperms.

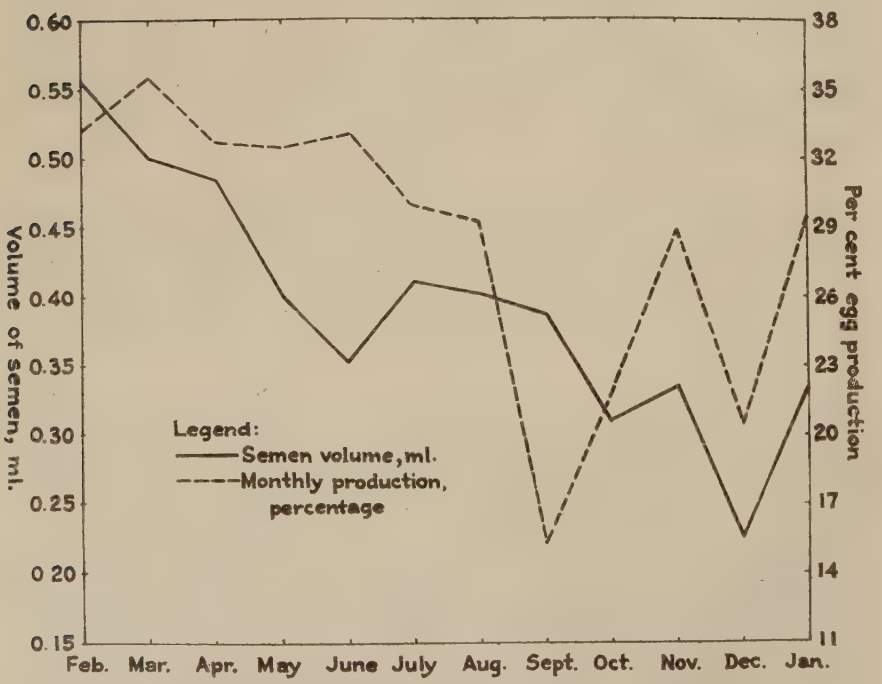
Volume of semen, ml.
Per cent egg production
Legend:
Semen volume, ml.
Monthly production, percentage
Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan.

Fig. 3.—The distribution of sperm production.

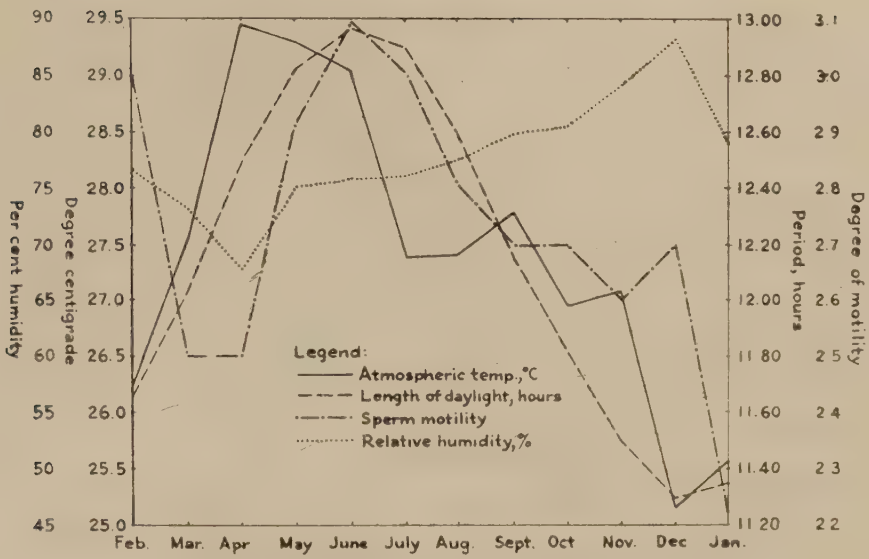

Fig. 4.—The mean monthly sperm motility.

Results of the monthly sperm motility tests appear very inconsistent, as shown in table 4 and figure 4. Sperm motility was generally at higher levels during the late spring and summer months of May and August.

The sperms' fertilizing efficiency was at its best in late winter, in February, and was depressed to the lowest level in late fall, in November (table 5 and fig. 5). It may be noted that fertility tended to increase during the first and last summer months, in June and in September.

Summary of semen characteristics

The averages of all the semen characteristics during the 12-month study period are shown in table 7. The average semen volume obtained in one collection was 0.39 ml. The data on semen volume reported by various investigators vary, depending upon the method of collection and, to a lesser extent, upon the breed. With semen collected by the massage method, Wheeler and Andrews (1943) observed a range of from 0 to 2.25 ml. in Barred Plymouth Rocks, whereas Parker, McKenzie, and Kempster (1942) noted 0.3 to 1.5 ml. in New Hampshires.

The average sperm concentration was 0.1 million in a milliliter of semen; the average number of sperms in an ejaculation was .039 million. Parker, McKenzie, and Kempster (1942) reported a range of from .03 to 11.2, whereas Wheeler and Andrews (1943) obtained .25 to 10.2. The work of Munro in 1938, as cited by Taylor (1949), showed that 100,000,000 sperms must be inseminated for optimum

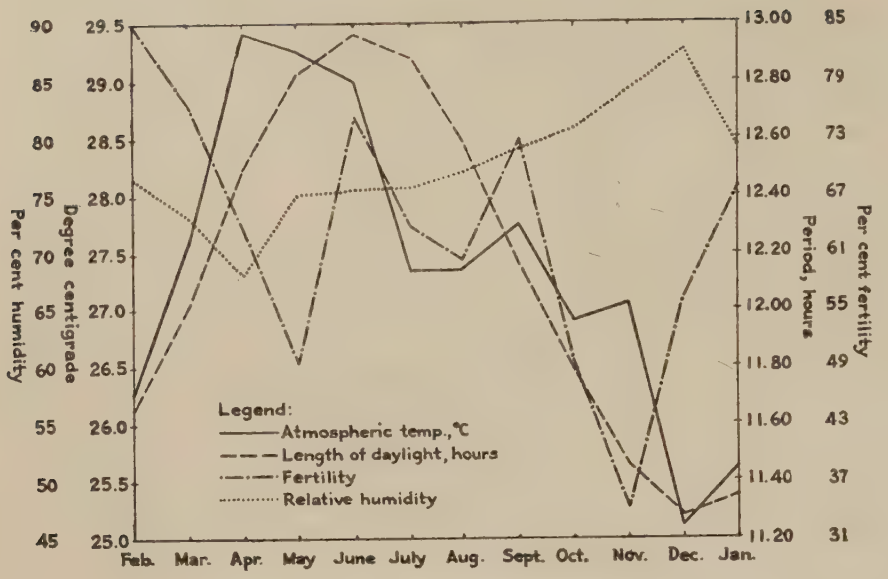

Fig. 5.—The sperms' fertilizing efficiency.

fertility. In spite of the low semen concentration observed in this study, the semen used in inseminations still effected a fair level of fertility. Incomplete preliminary findings in 1953 by Dr. G. V. Garcia, of the Department of Animal Husbandry, showed that the hemoglobin count of native goats ranged from 5.5 to 7, although these animals were apparently healthy.

Observations on semen color and turbidity are in accord with those of Parker, McKenzie, and Kempster (1942). Semen varied in appearance from a dense, opaque, white suspension with a high sperm concentration to a clear, watery fluid with a low sperm concentration.

An average sperm motility of 2.7 was observed. The excellent motility maintained by sperms when stored is apparently not related to their fertilizing efficiency. Garren and Shaffner (1951) found that the fertilizing capacity of sperms kept at 0 to 5°C. dropped sharply after a few minutes, but motility was best maintained at these levels. Young (1931) observed that sperms of guinea pigs lose their fertilizing ability much earlier than their motility. These are some instances when the motility of sperms is not a reliable index of their fertilizing efficiency.

The average fertility obtained was 62.8 per cent. This result would have been higher had not some hens continued to lay infertile eggs even after weekly inseminations.

Other observations

Several workers, including Burrows and Titus in 1939, Parker *et al.* in 1940, Raimo in 1942, and Jones in 1944, all cited by Taylor (1949), have shown that neither general appearance nor show of libido is necessarily related to sperm production. The present observations agree with the reports of those workers. Rooster No. 6, which was comparatively lighter than the others, yielded surprisingly large amounts of semen. While semen was more easily obtained from birds that showed a strong sex drive than from those that appeared more passive, practically just as much semen was collected. Rooster No. 3 was so wild that it hardly gave any semen. This bird, together with rooster No. 4 which got sick, had to be dropped from the study because of its failure to ejaculate. In general, roosters of better health and vigor and of milder temperament yielded more semen.

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TABLE 1

Monthly fluctuation in atmospheric temperature, relative humidity, and length of daylight

MONTH	PHYSICAL FACTOR		
	TEMPERATURE	HUMIDITY	DAYLIGHT
	°C.	*per cent*	*hours*
February	26.2	77.5	11.63
March	27.6	73.7	12.04
April	29.5	67.4	12.47
May	29.3	75.1	12.80
June	29.0	76.3	12.99
July	27.4	76.5	12.90
August	27.4	77.3	12.59
September	27.7	79.1	12.18
October	26.9	80.3	11.80
November	27.1	84.2	11.48
December	25.2	87.6	11.28
January	25.6	77.9	11.35
Average	27.2	78.3	12.04

TABLE 2

Seasonal fluctuation of semen volume

MONTH	SEMEN VOLUME
	ml.
February	0.56
March	0.50
April	0.49
May	0.40
June	0.35
July	0.42
August	0.41
September	0.39
October	0.31
November	0.34
December	0.23
January	0.34
Average	0.39

TABLE 3

Seasonal fluctuation of semen concentration in millions of sperms in a milliliter of semen

MONTH	SEMEN CONCENTRATION
February	.181
March	.151
April	.132
May	.125
June	.086
July	.090
August	.089
September	.085
October	.079
November	.083
December	.074
January	.077
Average	.104

TABLE 4

Seasonal fluctuation of sperm motility

MONTH	DEGREE OF MOTILITY
February	3.0
March	2.5
April	2.5
May	2.9
June	3.1
July	3.0
August	2.8
September	2.7
October	2.7
November	2.6
December	2.7
January	2.2
Average	2.7

TABLE 5

Seasonal fluctuation of the fertilizing efficiency of sperms

MONTH	FERTILITY
	per cent
February	84.7
March	75.8
April	64.2
May	48.7
June	75.8
July	63.7
August	60.4
September	73.2
October	50.2
November	33.9
December	55.6
January	67.7
Average	58.4

TABLE 6

Relation between physical factors and semen characteristics and interrelationships among the semen characteristics

PHYSICAL FACTOR AND SEMEN CHARACTERISTIC	NO. OF OBSERVATIONS	DEGREES OF FREEDOM	COEFFICIENT OF CORRELATION	SIGNIFICANCE 5%	SIGNIFICANCE 1%
Semen volume and atmospheric temperature	53	51	.272 [a]	.271	.351
" " " relative humidity	53	51	−.515 [b]	.271	.351
" " " length of daylight	53	51	.246	.271	.351
Semen concentration and atmospheric temperature	53	51	−.320 [a]	.271	.351
" " " relative humidity	53	51	−.448 [b]	.271	.351
" " " length of daylight	53	51	.051	.271	.351
Sperm motility and atmospheric temperature	53	51	.193	.271	.351
" " " relative humidity	53	51	−.753 [b]	.271	.351
" " " length of daylight	53	51	.393 [b]	.271	.351
Fertility and atmospheric temperature	48	46	.0003	.301	.368
" " relative humidity	48	46	−.004	.301	.368
" " length of daylight	48	46	.355 [a]	.301	.368
" " semen volume	48	46	.126	.301	.368
" " " density	48	46	.097	.301	.368
" " sperm motility	48	46	−.848 [a]	.301	.368

[a] Significant.
[b] Highly significant.

TABLE 7

Averages of physical factors and semen characteristics

PHYSICAL FACTOR OR SEMEN CHARACTERISTIC	AVERAGE
Atmospheric temperature	27.2°C.
Relative humidity	78.3 per cent
Length of daylight	12.04 hours
Semen volume	.39 milliliter
Semen concentration	.104 million
Sperm motility	2.7
Sperm fertility	62.8 per cent

COMPARISON OF THE RATES OF GROWTH AND MORTALITY OF NEW HAMPSHIRE AND SINGLE COMB WHITE LEGHORN CHICKENS [1]

JUSTO G. CAMMAYO

WITH FOUR TEXT FIGURES

The New Hampshire chicks maintained consistently higher weekly weights than the Single Comb White Leghorns throughout the experiment. The mean difference in weight between the males of the two lots was not significant in trials I, II, and III but was significant in trial IV. Among the females, the difference was not significant in trials I and III but was significant in trials II and IV. The S. C. White Leghorns required a smaller amount of feed for a kilogram gain but had a higher rate of mortality than the New Hampshires.

Of the breeds of chickens now being commercially raised in the Philippines, the New Hampshire and the Single Comb White Leghorn predominate. As to which of these two breeds is more profitable to raise is a question that is now very timely. With the aim of comparing the rate of growth and the rate of mortality of these two breeds, this study was carried out in the Department of Animal Husbandry from March, 1953, to February, 1954.

MATERIALS AND METHODS

Six hundred artificially hatched day-old chicks, consisting of New Hampshires and Single Comb White Leghorns in equal numbers, were used in this experiment. Four trials were conducted with 75 chicks of each breed to a trial. Every trial lasted for 12 weeks.

After the chicks had been wing banded, they were weighed initially and then weekly thereafter up to the weaning age of 12 weeks. The New Hampshire chicks were designated as lot 1 and the Single Comb White Leghorns as lot 2. The birds from both lots were confined separately in two identical pens situated side by side, their concrete floors littered with rice hull. Each pen was provided with an electrically heated brooding compartment and a ground space where the birds could get sunshine.

During the first three days, the chicks were confined in the heated brooders. After the third day, the chicks were let loose in the pens with access to the heated brooders at night until they had fully feathered.

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[1] Central Experiment Station Contribution No. 1775. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1954. Prepared in the Department of Animal Husbandry under the direction of Professor F. M. Fronda and Instructor A. C. Campos.

The lots were given the same ration, care, and management. The ration fed consisted of the following ingredients, all parts by weight:

Rice bran	55
Ground corn	20
Fish meal	20
Copra meal	5
	100

To every 100 parts of the mash were added 10 parts of dried cow manure and 1 part of table salt. The feed was made available to the birds at all times of the day. Chopped greens were given to them daily after they had reached two weeks of age.

Records were kept of the initial and weekly weights of the birds, amount and cost of feed consumed, and rate of mortality.

RESULTS AND DISCUSSION

Rate of growth. The rate of growth was measured in terms of weekly weights of the chicks (table 1 and figs. 1 to 4). The initial weights of the two lots were almost the same except in trial IV when chicks of lot 1, which were obtained from the Santa Fe Poultry Farm, were heavier than those of lot 2. The mean weight of lot 1 on the third week was about three times its initial weight, and lot 2 at the same age was just slightly heavier than twice its initial weight. The New Hampshire chicks, males and females, maintained consistently higher weekly weights than the Single Comb White Leghorns in all trials throughout the experimental period.

Fronda and Yñiguez [2] reported a lower twelfth-week weight of only 468.8 grams for Single Comb White Leghorns, and Castillo [3] observed a weight of 652.6 ± 22.0 grams for the same breed. According to Kempster,[4] New Hampshires gain an average of 1.03 kilograms (2.26 pounds) after 12 weeks, and Single Comb White Leghorns, 1 kilogram (2.20 pounds). These figures are markedly higher than the results of the present study. Mendoza [5] also reported higher weights for the two breeds.

When the weights of the two breeds were compared by sex, it was observed that the New Hampshire males were heavier in all the trials than the S. C. White Leghorn males (table 2). Statistical analysis revealed, however, that the mean difference was not significant in trials I, II, and III, but it was significant in the last trial. Except in trial I when the S. C. White Leghorn females were heavier than the New Hampshire females, the results were in favor of the New Hampshire females. The mean difference in trials I and III was not significant, but in trials II and IV it was significant.

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[2] F. M. Fronda and B. T. Yñiguez, *Philippine Agriculturist*, 25, 105 (1936).
[3] Leopoldo S. Castillo, *Philippine Agriculturist*, 32 124 (1948).
[4] H. L. Kempster, *Missouri Agric. Exper. Sta. Bull.*, 423 (1941).
[5] Teofilo M. Mendoza, *Philippine Agriculturist*, 33, 257 (1949).

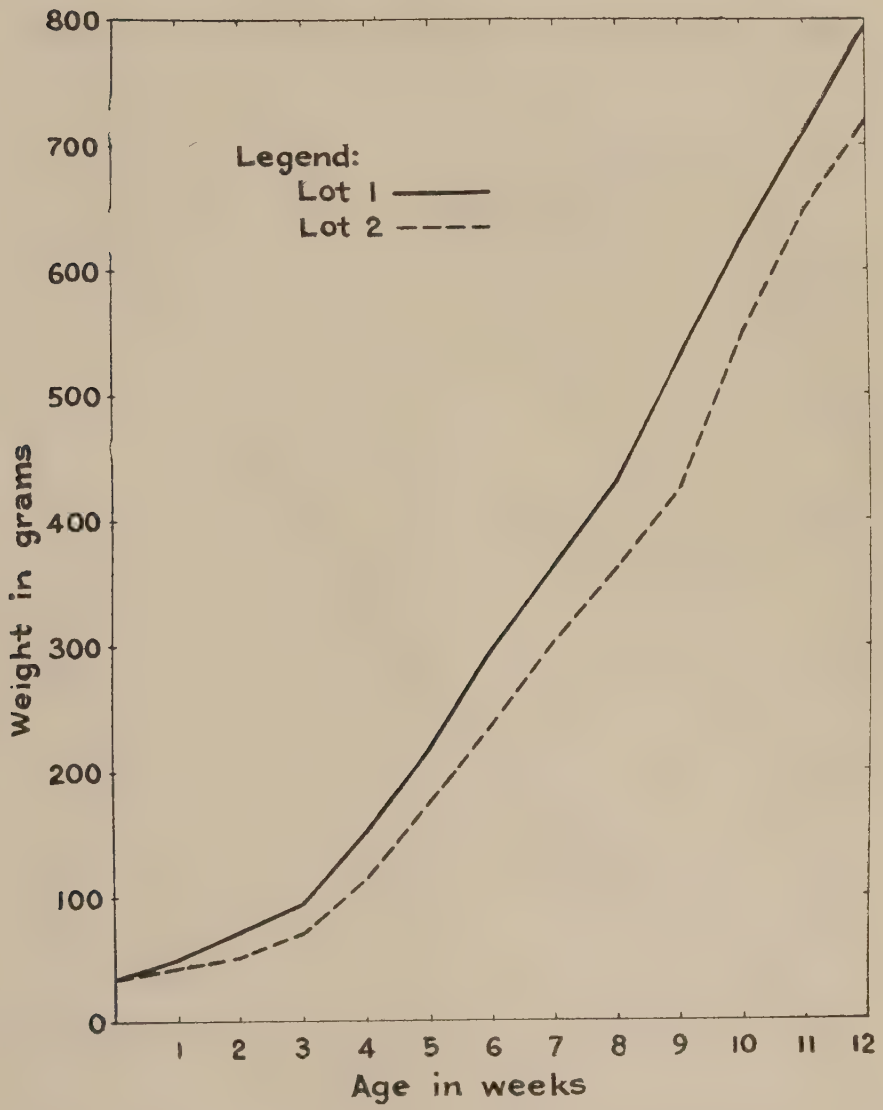

Fig. 1.—The rate of growth in trial I measured in terms of weekly weights of chicks.

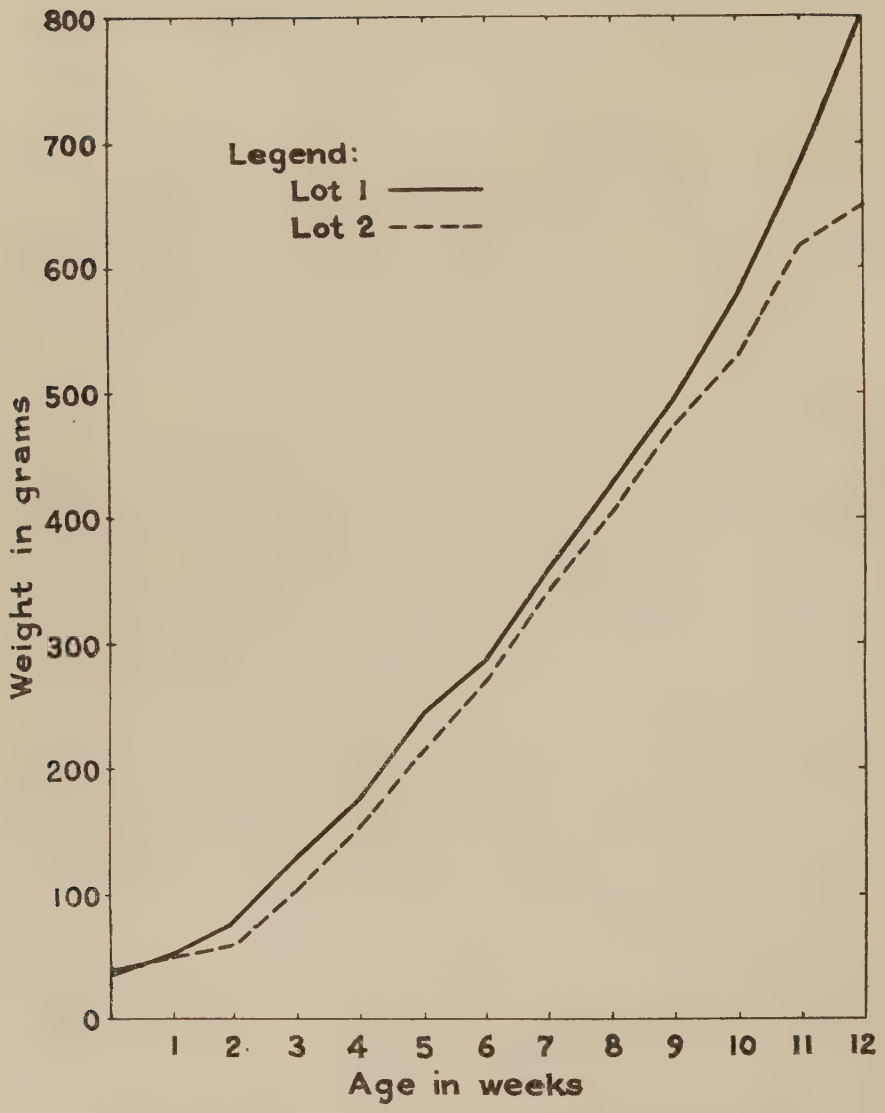

Fig. 2—The rate of growth in trial II measured in terms of weekly weights of chicks.

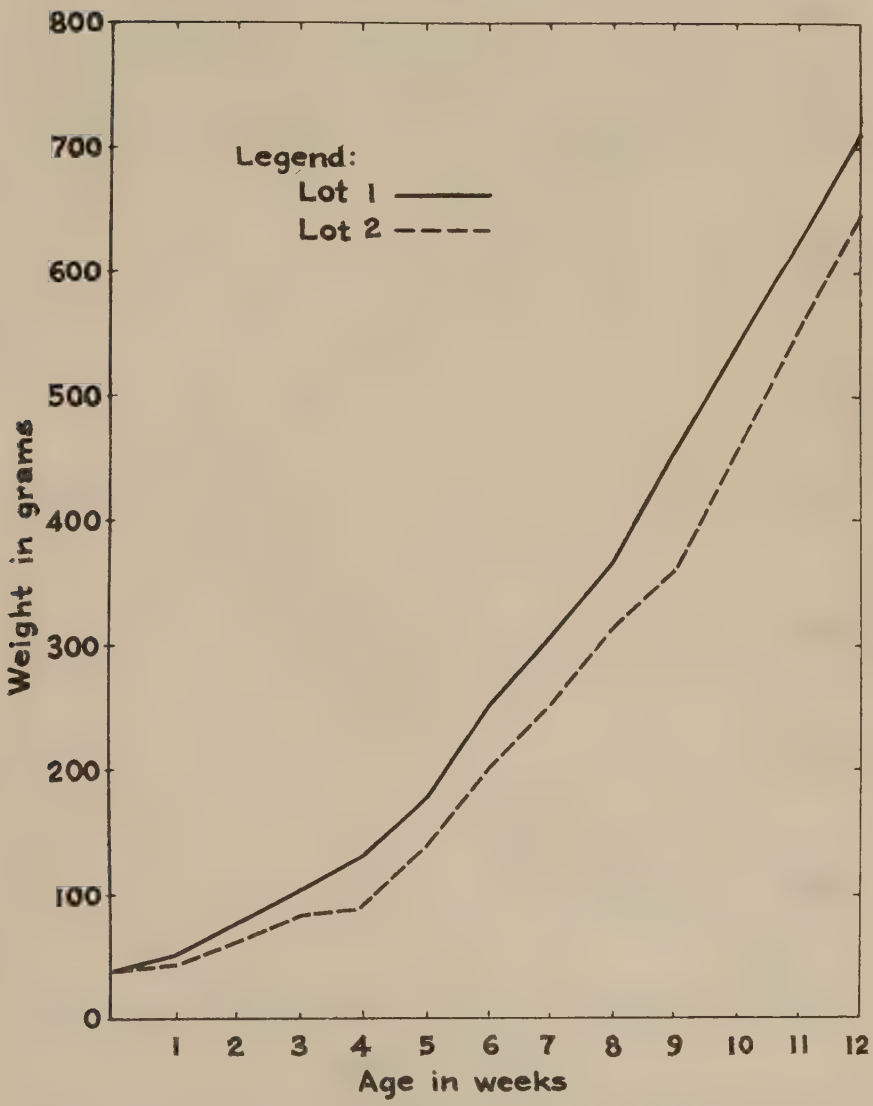

Fig. 3.—The rate of growth in trial III measured in terms of weekly weights of chicks.

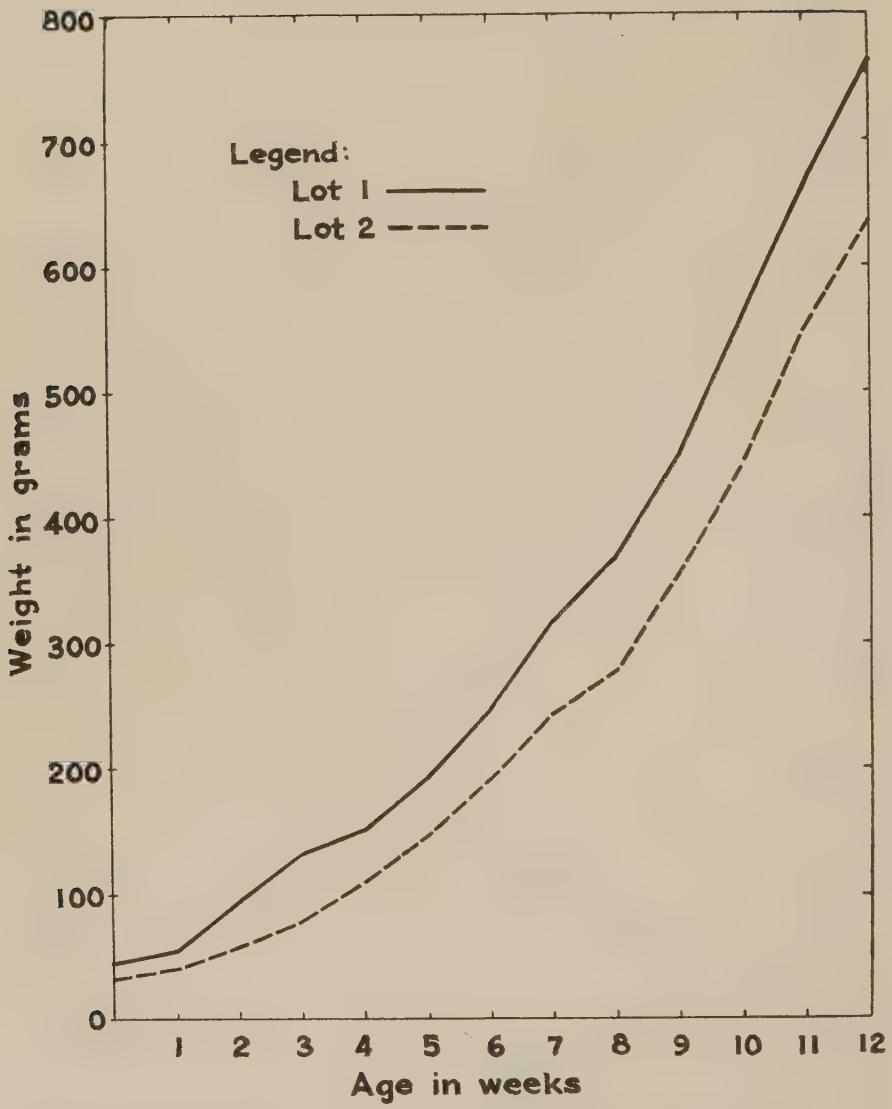

Fig. 4.—The rate of growth in trial IV measured in terms of weekly weights of chicks.

Feed consumption. Table 3 shows the amount and cost of feeds required to produce a kilogram gain in live birds for 12 weeks. Judged by the amount of feed needed for a kilogram gain, lot 2 was more efficient in all of the trials than lot 1.

Rate of mortality. A high percentage of mortality was incurred by the two lots in trials I and III and by lot 2 in trial IV (table 4). In general the S. C. White Leghorns had a consistently higher rate of mortality in all of the trials. The occurrence of roup and coccidiosis during the early part of the trials accounted for this high rate of mortality.

TABLE 1

Average initial and weekly weights of the chicks in grams

AGE IN WEEKS	NEW HAMPSHIRE (LOT 1)				SINGLE COMB WHITE LEGHORN (LOT 2)				MEAN	
	Trial I	Trial II	Trial III	Trial IV	Trial I	Trial II	Trial III	Trial IV	Lot 1	Lot 2
Initial	37.1	36.2	38.5	41.2	37.3	36.9	38.7	33.4	38.2	36.6
1	49.9	51.7	51.3	56.9	46.9	50.3	44.3	43.6	52.6	47.0
2	71.2	73.5	79.8	94.4	58.7	61.9	61.9	59.6	80.1	60.4
3	97.5	122.8	104.9	133.5	74.4	100.7	84.4	78.5	115.2	86.8
4	152.2	171.7	133.1	154.4	114.9	152.3	93.7	110.6	153.8	119.3
5	221.1	243.2	189.3	196.9	176.6	217.2	141.8	150.7	214.9	176.9
6	294.0	282.5	254.9	250.3	235.2	272.7	201.8	195.7	271.2	233.9
7	364.7	357.8	306.0	314.0	300.2	345.6	253.4	243.0	335.9	293.7
8	429.2	429.7	366.1	384.9	363.5	400.1	315.3	279.4	403.3	347.7
9	530.1	490.2	453.1	470.0	441.9	455.5	379.9	351.8	483.3	414.3
10	629.0	576.8	534.2	574.3	551.3	524.8	458.9	431.8	578.8	496.8
11	737.8	664.4	621.5	665.6	670.1	617.7	548.8	547.2	671.8	598.9
12	794.0	801.8	710.5	760.6	742.8	669.4	647.5	633.5	771.8	678.7
Mean	±23.9	±32.4	±16.1	±22.7	±17.2	±22.4	±12.1	±25.1	±13.8	±10.1

TABLE 2

Comparison of weights of New Hampshire and S.C. White Leghorn chickens at twelve weeks of age

TRIAL	LOTS COMPARED	NO.	SEX	DEGREES OF FREEDOM	MEAN DIFFERENCE	STANDARD ERROR OF DIFFERENCE	COMPUTED "t"	LEVEL OF SIGNIFICANCE		REMARKS
								5%	1%	
					grams					
I	1–2	47	Male	45	78.6	43.08	1.824	2.014	2.690	Not significant
	1–2	36	Female	34	1.8	35.83	.050	2.032	2.730	Not significant
II	1–2	60	Male	58	132.4	68.60	1.930	2.002	2.664	Not significant
	1–2	68	Female	66	124.7	28.50	4.375	1.996	2.653	Significant
III	1–2	37	Male	35	49.3	25.68	1.920	2.030	2.724	Not significant
	1–2	33	Female	31	41.7	26.28	1.586	2.039	2.753	Not significant
IV	1–2	48	Male	46	133.6	38.90	3.434	2.013	2.687	Significant
	1–2	56	Female	54	102.2	34.96	2.923	2.005	2.670	Significant

TABLE 3

Amount and cost of feed required to produce a kilogram gain in weight

ITEM	TRIAL I		TRIAL II		TRIAL III		TRIAL IV		AVERAGE	
	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2
Amount of feed consumed, kg.	176.78	122.77	236.66	169.61	116.34	80.78	225.85	114.73	188.91	120.45
Weight of weanling produced, kg.	34.94	28.97	52.92	41.50	26.29	21.37	47.16	27.51	40.33	29.84
Amount of feed required to produce a kilogram gain, kg.	5.50	4.69	4.71	4.22	4.97	4.37	5.12	4.59	5.06	4.47
Cost of feed required to produce a kilogram gain, pesos [a]	1.54	1.31	1.32	1.18	1.39	1.22	1.43	1.39	1.42	1.25

[a] Cost of a kilogram of feed, ₱0.28.

TABLE 4

Mortality rate

	NEW HAMPSHIRE (LOT 1)					S. C. WHITE LEGHORN (LOT 2)				
	Trial I	Trial II	Trial III	Trial IV	Total	Trial I	Trial II	Trial III	Trial IV	Total
Number of chicks at start	75	75	75	75	300	75	75	75	75	300
Number of chicks after 12 weeks	44	66	37	62	209	39	62	33	42	176
Number of chicks that died	31	9	38	13	91	36	13	42	33	124
Percentage of mortality	41.3	12.0	50.7	17.3	30.3	48.0	17.3	56.0	44.0	41.3

THE DIGESTIBILITY BY SWINE OF RICE BRAN, COPRA MEAL, COCONUT MEAT, COCONUT RESIDUE, AND TWO CONCENTRATE MIXTURES [1]

J. K. Loosli,[2] Jesus O. Peña, L. A. Ynalvez, and Valente Villegas [3]

Rice bran with less crude fiber had more digestible organic matter and protein than rice bran high in fiber content. The digestibility of concentrates containing the two kinds of rice bran also varied appreciably. Protein, organic matter, fiber, and N.F.E. of fresh coconut meat were more digestible than those of copra meal. It appears that the expeller method of processing lowers the digestibility of copra meal by swine.

The two most abundant and commonly used concentrate feeds for swine in the Philippines are rice bran and copra meal. These concentrates have proved satisfactory as swine feeds in several experiments at the College of Agriculture, but their digestibility has not been studied yet in the Philippines.

Schneider [4] reports a digestion experiment conducted in Germany on two pigs fed copra meal in 1876. A survey of the literature on the subject indicates that further studies have not been carried out. In other countries copra meal is fed largely to cattle and sheep. Fraps, according to Schneider, made the only digestion study using rice bran for pigs in 1932.

The great importance of rice bran and copra meal to swine in the Philippines and the meager data on their value stress the desirability of conducting studies on the digestibility by swine of rice bran, copra meal, coconut meat, coconut residue (*sapal*), and two concentrate mixtures.

EXPERIMENTAL METHODS

A total of 31 digestion trials was carried out to test the value of different grades of rice bran, various coconut products, and concentrate mixtures containing these feeds.

Three- to five-month-old weanling barrows of the Berkjala breed were used in the tests. Before the start of the experiment, the pigs were treated with phenothiazine, 5.0 grams to a pig, to eliminate intestinal parasites. The pigs were maintained in separate pens constructed to permit the quantitative collection of all feces and the gathering of accurate data on feed intakes. The feeds to be studied were given once daily in amounts that could be eaten at one feeding. After the intakes had been standardized to a constant level, they were kept uniform for five to seven days before fecal collections were

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[1] Central Experiment Station Contribution No. 1776.

[2] Visiting professor of animal husbandry from Cornell University.

[3] The authors gratefully acknowledge the assistance of Lolita Austria and Epifania Cruz in making the chemical analyses and that of S. E. Claud in caring for the experimental animals.

[4] B. H. Schneider, *West Virginia Agric. Exper. Sta. Bull.* (1947).

started and also during the seven-day collection period. Aliquots (10 to 25 per cent) of the daily feces were dried under infrared lamps and stored in sealed Mason jars until analyzed. Body weights were recorded at the start and end of each digestion trial. The pigs were given fresh water, salt, and ground oyster shells *ad libitum* during the trials.

RESULTS AND DISCUSSION

The chemical analyses of the feeds studied are summarized in table 1.

The digestion coefficients for fine rice bran fed alone and for the concentrate mixtures are summarized in table 2. Rice bran sample No. 13, having less crude fiber, less ash, and slightly more protein and ether extract than sample No. 225, was appreciably more digestible with respect to organic matter, crude protein, and nitrogen-free extract (N.F.E.). The digestibility of the crude fiber and of the ether extract did not differ greatly.

Studies were also carried out with two concentrate mixtures containing 15 per cent yellow flint corn, 60 per cent fine rice bran, 16 per cent copra meal, 7 per cent fish meal, 1.5 per cent shells, and 0.5 per cent salt. The same percentages of the various ingredients were used in both mixtures, but the kinds of rice bran differed.

Concentrate mixture No. 17 containing rice bran from lot 13 was fed in two series of trials to the same pigs. In the first series on September, 1953 (table 2), the pigs were approximately three months of age. The trials were repeated in January, 1954, when the pigs were seven months old. Except for crude fiber, the digestion coefficients were very similar on the two dates. Thus, it may be seen that the age of the pigs studied did not influence the digestibility of the feed except, possibly, to increase slightly the digestibility of crude fiber. The uniformity of the results adds to the reliability of the other comparisons.

Concentrate mixture No. 248 contained rice bran from lot No. 225, but it was similar in all other ingredients to mixture No. 17. The digestibility of all its nutrients was appreciably lower than that of mixture No. 17, which contained the better quality rice bran. Both lots of rice bran were purchased as "fine" rice bran at approximately the same price. They differed greatly in feeding value.

Chemical analyses were made of two additional lots of the same concentrate mixture fed to the swine herd during the year. The analyses showed the large variations in fat, fiber, and ash content (table 1). One of the lots, No. 107, containing 19 per cent fiber and 20 per cent ash, can hardly be considered a concentrate and certainly is not a satisfactory feed for weanling pigs. Analyses have shown corn and copra meal to be fairly uniform in composition. The great variability was caused by the rice bran. It is the authors' opinion that the lack of uniformity of rice bran and the failure to regulate its quality are serious handicaps to the profitable production of eggs, pork, and milk in the Philippines.

The digestion coefficients for the coconut products are shown in table 3. It is apparent that the organic matter and crude fiber of copra meal were more digestible in the first three trials than in the second series of trials. The authors are uncertain whether the differences were due entirely to the copra meal samples or partly to the difference in age of the pigs used in the tests, the animals in the last trials being slightly younger. The mean of all six trials is probably a more reliable estimate of the digestibility of copra meal by growing pigs than the results of either series alone. The influence of the age of pigs upon the digestibility of feeds should be studied further.

Thirteen trials were conducted to determine the digestibility of fresh coconut meat and fresh coconut residue (*sapal*, residue from coconut milk production) fed alone or with concentrate mixtures. The most striking difference was that the protein of the fresh coconut meat was more digestible than that of the copra meal (table 3). Organic matter and N.F.E. followed the same trend. These data strongly suggest that the processing of copra by the expeller method lowers the digestibility of the protein and, perhaps, also that of the carbohydrates. This theory should be confirmed with a view to improving copra meal as a feed for swine and poultry.

Six pigs were started on fresh coconut meat as their only feed. Two of the animals developed diarrhea and went "off their feed" so that satisfactory digestion trials could not be conducted with them. When a concentrate mixture was fed as 50 per cent of the feed allowance along with the coconut meat, no digestive disturbance occurred. It is evident from this experiment that fresh coconut meat is not satisfactory as the sole feed for young pigs recently weaned.

An attempt was made to give fresh coconut residue as the only feed, but the pigs refused to eat it. When the product was sun-dried and fed along with an equal weight of concentrate, it was readily eaten.

Summarized in table 4 are the digestion coefficients for the rice bran and copra products obtained in these trials and the values reported by Morrison [5] and Schneider.[6] The present data were more extensive than those previously reported. The digestibility of protein was the same as that reported by Schneider. The mean value for fat was higher, and those for fiber and N.F.E., slightly lower. The coefficients for the best quality rice bran were higher than Schneider's values for all nutrients. Morrison's coefficients were averages for cattle and sheep and might be expected to be higher for swine.

The digestible protein and total digestible nutrient content of rice bran and copra meal are also shown in table 4. The copra meal studied was slightly lower in digestible protein content but higher in T.D.N. content.

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[5] F. B. Morrison, "Feeds and Feeding," Morrison Publishing Co., Ithaca, New York, 1951, 21st ed.

[6] Schneider, *op. cit.*

TABLE 1

Chemical composition of the feeds

FEED	SAMPLE NO.	MOISTURE	PROTEIN	ETHER EXTRACT	CRUDE FIBER	N.F.E.	ASH
		per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
Fine rice bran ("Cono")	13	12.30	10.98	11.66	7.87	47.27	9.92
	225	11.78	9.11	9.41	16.74	40.71	12.25
Copra meal	12	9.07	18.97	7.95	9.13	49.75	5.13
	266	7.62	22.54	6.26	10.74	48.24	4.60
	Mean	8.30	20.80	7.10	9.90	49.00	4.90
Fresh coconut meat	85	48.70	5.00	33.03	2.19	9.58	1.50
Coconut residue (*sapal*)	51	47.85	3.38	28.90	18.18	0.98	0.71
	306	47.97	3.36	22.48	15.20	9.99	1.00
Concentrate mixture No. 2	17	12.63	13.25	11.63	6.78	47.12	8.59
	248	7.65	15.05	6.06	11.70	49.08	10.46
	107	6.96	14.38	5.90	19.35	32.79	20.62
	146	10.82	14.19	3.57	11.88	47.90	11.64
	307	8.87	16.15	1.08	5.46	60.38	8.06

TABLE 2

Digestion coefficients for rice bran and the concentrate mixtures

FEED	ANIMAL NO.	ORGANIC MATTER	CRUDE PROTEIN	ETHER EXTRACT	CRUDE FIBER	N.F.E.
Rice bran, fine, No. 13	1526	80.4	77.6	84.5	47.3	85.5
	1527	81.0	80.3	89.7	48.8	84.3
	1541	82.7	80.7	92.4	55.7	85.2
	Mean	81.4	79.5	88.9	50.6	85.0
No. 225	1728	75.7	68.7	88.8	55.2	79.1
	1729	70.8	63.7	82.4	42.4	76.9
	1731	77.7	74.2	86.2	57.3	81.6
	Mean	74.7	68.9	85.8	51.6	79.2
Concentrate mixture		*September, 1953*				
No. 17 (containing rice bran No. 13)	1526	80.5	76.9	89.2	39.4	85.2
	1527	81.4	77.2	84.7	47.5	86.6
	1541	81.2	83.2	85.9	36.9	87.4
		January, 1954				
No. 17	1526	84.4	78.4	89.0	62.5	88.8
	1527	82.3	76.0	91.1	60.0	85.1
	1541	80.4	69.4	88.8	59.2	84.6
	Mean	81.8	76.8	88.1	50.9	86.3
No. 248 (containing rice bran No. 225)	1728	69.3	66.1	77.7	33.1	77.7
	1729	74.3	74.9	84.7	42.3	80.4
	1731	71.6	72.1	81.0	37.6	78.3
	Mean	71.1	71.0	81.1	37.0	78.8

TABLE 3

Digestion coefficients for copra meal, coconut meat, and sapal

FEED	ANIMAL NO.	ORGANIC MATTER	CRUDE PROTEIN	ETHER EXTRACT	CRUDE FIBER	N.F.E.
Copra meal (expeller process)	1526	80.3	77.4	88.2	59.8	83.5
	1527	77.7	75.7	87.9	58.3	80.4
	1541	84.0	78.5	92.6	68.3	79.3
	Mean	80.7	77.2	89.6	62.1	81.1
	1728	57.6	66.4	88.1	23.3	57.1
	1729	65.9	70.0	90.4	39.1	66.7
	1731	66.9	72.7	90.7	48.4	65.0
	Mean	63.5	69.7	89.7	36.9	62.9
Six trials	Mean	72.1	73.4	89.6	49.5	72.0
Fresh coconut meat	1526	94.0	84.8	95.9	84.5	94.5
	1527	92.5	84.0	94.8	84.5	90.9
	1541	94.0	88.0	97.3	86.4	91.1
	1529	90.8	78.5	93.9	80.7	88.9
	Mean	92.8	83.8	95.4	84.0	91.4
Coconut meat plus concentrate	1526	93.2	90.8	98.0	75.8	91.9
	1527	91.5	89.4	97.9	68.3	90.7
	1541	91.7	89.2	97.6	71.0	91.2
	Mean	92.1	89.8	97.8	71.7	91.3
	1728	77.5	69.3	84.3	37.0	81.3
	1729	84.7	76.6	91.5	56.1	86.5
	1731	79.1	76.9	90.6	28.9	79.0
	Mean	80.4	74.3	88.8	40.7	82.3
Six trials	Mean	86.2	82.0	93.3	56.2	86.8
	1817	85.0	75.4	65.0	83.1	88.4
Coconut residue (*sapal*) plus concentrate	1872	90.5	87.2	79.0	87.8	92.5
	1874	86.3	80.7	74.8	84.7	88.2
	Mean	87.3	81.1	72.9	85.2	89.7

TABLE 4

Average digestible nutrients and digestion coefficients compared with previously published data

FEED	DRY MATTER	DIGESTIBLE PROTEIN	T.D.N.	PROTEIN	FAT	FIBER	N-FREE EXTRACT	NO. OF TRIALS
	per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	
Present report								
Copra meal	91.7	15.2	69.9	73	90	50	72	6
Fresh coconut meat ..	51.3	4.2	85.3	84	95	84	91	4
Rice bran, fine (13) ..	87.7	8.8	76.4	80	89	51	85	3
" " " (225)	88.2	6.3	65.4	69	86	52	79	3
Schneider's data								
Copra meal	85.3	16.9	72.7	73	83	60	89	2
Rice bran	90.8	10.0	73.6	76	86	20	81	2
Rice bran ..... (by difference)	92.5	8.5	60.1	67	80	20	65	2
Morrison's data [a]								
Copra meal	93.2	18.1	77.7	85	100	46	82	7
Rice bran	90.9	8.5	67.0	68	83	28	76	22

[a] These data are not limited to studies with swine.

EFFECTS OF RICE STRAW WITH VARYING AMOUNTS OF AVAILABLE NITROGEN ON SOME PHYSICAL AND CHEMICAL PROPERTIES OF LIPA CLAY LOAM PLANTED TO RICE [1]

BONIFACIO C. FELIZARDO

WITH ONE TEXT FIGURE

In comparison with the untreated lot, Lipa clay loam to which 40 grams of fresh rice straw had been added 60 days before rice was planted in it showed high pH and potassium content of the soil at the booting stage of the plants but lower grain and straw yields. Ammonium sulfate applied at the rate of 1.30 grams to a pot increased the nitrogen content of the soil and the yields of grain and straw. It decreased the potassium content of the soil. The application of the ash of 40 grams rice straw with 1.30 grams of ammonium sulfate resulted in a higher nitrogen content of the soil than that of the control and in higher straw and grain yields. It decreased the pH and the potassium content of the soil. Nitrogen of the soil and yields of straw and grain increased with the application of ammonium phosphate at the rate of 1.70 grams to a pot. The pH and the potassium of the soil decreased, however. The ash of 40 grams rice straw with 1.70 grams of ammonium phosphate increased the nitrogen of the soil and the yield of straw but decreased the pH and the potassium of the soil. When the rate of ammonium phosphate was raised to 8.50 grams to a pot, the available phosphorus of the soil was increased.

Many soil investigators agree that rice straw, when allowed to decompose, is beneficial to the soil. However, most farmers still burn the plant residues in the field after harvest. This practice deprives the soil of the nitrogen in the straw so that nitrogenous fertilizers have to be applied to the rice plants.

To determine the effects of fresh rice straw and rice straw ash mixed with varying amounts of either ammonium sulfate or ammonium phosphate on the pH, clay fraction, organic matter, total nitrogen, available phosphorus, and exchangeable potassium of Lipa clay loam planted to rice, this study was conducted in the Department of Soils from June, 1953, to March, 1954. The grain and straw yields were also measured to determine the crop response to the different treatments.

Pfeiffer *et al.* (1909), as cited by Espino and Pantaleon (1934), noted that wheat straw had harmful effects on plants. Waksman (1924) suggested that the straw was being used by the bacteria as a source of carbon. The nitrogen which should have been available to the plants was utilized instead for the building up of the bacterial protoplasm.

[1] Central Experiment Station Contribution No. 1777. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1954. Prepared in the Department of Soils under the direction of Dr. Nicolas L. Galvez.

Espino and Pantaleon (1934) reported that the presence of fresh rice straw, rice straw ash, and both fresh straw and ash in clay loam soil was harmful to the growth and development of young rice plants. However, when fresh rice straw was allowed to decompose in the soil for more than 75 days, it not only lost its harmful effects but also proved nutritive and stimulating to the growth and development of the young rice plants.

Talamisan (1938) reported that ammonium sulfate mixed with superphosphate and applied to Lipa clay loam did not result in higher yields of straw and grain than ammonium sulfate applied alone. Calma, Galvez, and Velasco (1952) further reported that Lipa clay loam does not need the addition of phosphorus in order to produce a good crop of rice.

Rola and Galvez (1948) found that a pH range from 3.7 to 6.2 was the best for the growth of upland rice.

Aldrich and Turrell (1950) indicated that acidification of the soil appreciably increased the potassium, magnesium, phosphorus, sodium, and sulfur in alfalfa grown in pots and, at the same time, decreased these elements in the soil. They inferred that hydrogen replaced the exchangeable cations in the soil so that these elements became available to the plants. Galvez and Subido (1941) reported that potassium is the highest of all the exchangeable bases absorbed by rice. Lyon, Buckman, and Brady (1952) described the luxury consumption of potassium by plants.

Lyon, Buckman, and Brady (1952) explained that nitrogen-containing materials have residual effects on the soil. They pointed out that compounds which supply the ammonium form of nitrogen ultimately increase the acidity of the soil.

MATERIALS AND METHODS

Lipa clay loam was collected from the Central Experiment Station lowland rice field. The surface soil of grayish black was about twenty centimeters deep. It was hard to pulverize when dry, and it was sticky and plastic when wet. It had a maximum water-holding capacity of 75.61 per cent and a pH of 5.6. It contained 46.25 per cent clay, 25.25 per cent silt, 25.50 per cent sand, and 3.52 per cent organic matter. Its plant foods held in reserve were 0.15 per cent nitrogen, 0.42 per cent calcium oxide, 0.41 per cent magnesium oxide, 0.34 per cent phosphoric acid, 0.17 per cent potassium oxide, and 0.62 per cent sodium oxide.

A sufficient amount of soil was air-dried, pulverized, screened through a one-centimeter sieve, and then thoroughly mixed. Thirty-two earthen pots, each with an average area of 0.068 square meter and a height of 35 centimeters, were painted on the inner side with coal tar to prevent leaching through the pores. The pots were each filled with 18 kilograms of soil and were grouped into four replications of eight lots each. Lot I, the control, received no treatment; lot II received 40 grams of rice straw; lot III, 1.30 grams of ammo-

nium sulfate; lot IV, the ash of 40 grams of rice straw and 1.30 grams of ammonium sulfate; lot V, the ash of 40 grams of rice straw and 6.50 grams of ammonium sulfate; lot VI, 1.70 grams of ammonium phosphate; lot VII, the ash of 40 grams of rice straw and 1.70 grams of ammonium phosphate; and lot VIII, the ash of 40 grams of rice straw and 8.50 grams of ammonium phosphate.

Fresh rice straw from the Central Experiment Station rice field was chopped to a length of about one centimeter and then mixed thoroughly with the soil 60 days before planting. Ash was also mixed with the soil in the same manner.

Ammonium sulfate containing 21 per cent nitrogen and ammonium phosphate containing 16 per cent nitrogen and 20 per cent phosphorus were applied on the thirtieth, fortieth, and fiftieth days after planting. One-third of the total amount was applied each time.

Guinangang rice seedlings were transplanted to the pots on June 25, 1953, right after germination, at the rate of five seedlings to a pot. When about ten centimeters high, the seedlings were thinned down to one plant to a pot. All the treatments were applied following a randomized scheme.

Soil samples were collected from each pot at the booting stage of the plants, air-dried, pulverized finely, sieved through a one-millimeter mesh sieve, and then kept for analyses. The pH of the soil was determined according to the method of Peach and English (1944); the clay fraction, by the Bouyoucos method described by Piper (1947); the organic matter, by the method described by Peech, Dean, Alexander, and Reed;[2] the total nitrogen content, by the A.O.A.C. (1945) method; the phosphorus content, by the Truog (1930) method; and the potassium content, by the method outlined by Wolf and Ichisaka (1947).

The grains and straw were harvested separately, air-dried, and then oven-dried at 100°C. to a constant weight. The empty grains were separated by the float method.

DISCUSSION OF RESULTS

Cultural observations. The observation that plants in the lot to which fresh rice straw had been added were pale and stunted during their entire growth period corroborates the findings of Espino and Pantaleon (1934), Pfeiffer (1909), and Waksman (1924). The plants in the lots treated with ammonium sulfate and ammonium phosphate were tall, produced many tillers, and had green and broad leaves (table 7 and fig. 1). This finding agrees with the observations of Talamisan (1938).

Effects on the clay fraction. All the treatments did not produce any significant change in the clay content of the soil (table 1).

Effects on the pH. Lot II, the straw-treated lot, gave a higher pH than any of the other lots (table 2). The same result was ob-

[2] M. Peech, L. T. Alexander, L. A. Dean, and J. F. Reed, *USDA Cir. 1757* (1947).

FIG. 1.—The rice plants at harvest time: I—control, no treatment; II—40 grams of rice straw; III—1.30 grams of ammonium sulfate; IV—ash of 40 grams straw plus 1.30 grams of ammonium sulfate; V—ash plus 6.5 grams ammonium sulfate; VI—1.70 grams ammonium phosphate; VII—ash plus 1.70 grams ammonium phosphate; and VIII—ash plus 8.50 grams of ammonium phosphate. (*Photographed by the Photographic Division.*)

served by Espino and Pantaleon (1934). The mechanism of this phenomenon, however, is not clear. Lot I, the control, and the lot treated with ammonium sulfate alone had the same pH value. Lots VII and VIII had the lowest pH among the treatments.

Effects on the organic-matter content. Neither ash nor fresh rice straw increased the organic-matter content of the substrate (table 3).

Effects on the nitrogen content. The control and the lot treated with rice straw alone had the same nitrogen content (table 4). It may be inferred that the addition of 40 grams of fresh rice straw to 18 kilograms of soil was not enough to produce a change in the nitrogen content of the soil. As was expected, the ammonium sulfate and ammonium phosphate treatments increased the nitrogen content of the soil.

Effects on the available phosphorus content. The addition of fresh rice straw alone did not produce any change in the phosphorus content of the soil (table 5). However, an increase over the phosphorus content of the control was shown when the straw was burned

and the ash was combined with 8.50 grams of ammonium phosphate. phosphate.

Effects on the potassium content. Potassium increased in lot II and decreased in lots III, IV, V, VI, VII, and VIII (table 6). The decrease in potassium may be due to the increase in the acidity of the soil. This trend was observed earlier by Aldrich and Turrell (1950) in pot cultures.

Effects on the yields of straw and grain. At harvest time, the yields of grain of lots III, IV, V, VI, and VIII (table 8) and the yields of straw of lots III, IV, V, VI, VII, and VIII (table 9) were higher than those of lot I, the control. All these lots, except lot I, received either ammonium sulfate or ammonium phosphate. The application of fresh rice straw tended to decrease the yields of both grain and straw. When the ammonium sulfate and ammonium phosphate treatments were compared, no marked difference was observed in both grain and straw yields. These results support the finding of Trelease (1920) that Lipa clay loam only needs nitrogen in order to grow a good crop of rice.

Lot II had the smallest loss in weight after sun-drying of the grains, and lot VII had the largest (table 10). Lot II also had the lowest percentage of empty grains, and lot V had the highest. Lot IV gave the smallest grain to straw ratio, and lot VII gave the biggest.

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TABLE 1

Clay fraction of the soil in per cent during the booting stage of the rice plants

REPLICATION	TREATMENT							
	I	II	III	IV	V	VI	VII	VIII
	46.22	48.85	46.28	47.25	46.28	45.58	46.58	46.28
1	46.28	48.98	46.22	47.25	46.58	46.22	46.28	46.58
	47.25	47.35	47.34	46.58	47.25	47.34	47.34	48.30
2	47.25	47.34	47.35	46.28	47.34	47.34	48.34	48.38
	46.58	46.22	46.58	45.28	47.34	46.28	48.28	47.34
3	46.28	47.25	46.28	45.22	47.25	46.28	48.48	47.34
	46.34	46.58	47.25	47.34	47.75	44.75	46.28	47.25
4	45.34	47.34	47.25	47.34	45.28	45.75	46.28	46.56
Total	371.54	379.91	374.55	372.54	375.07	369.54	377.86	377.93
	46.44	47.48	46.81	46.56	46.88	46.19	47.23	47.24

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Treatment	7	11.0966	1.5852	1.20	2.43	3.50
Pots within treatment	24	31.6119	1.3172	6.78	1.86	2.42
Determination within the pot	32	6.1150	0.1942			
Total	63	48.8235				

TABLE 2

The pH of the soil during the booting stage of the rice plants

REPLICATION	TREATMENT							
	I	II	III	IV	V	VI	VII	VIII
	5.57	5.61	5.59	5.52	5.50	5.51	5.54	5.45
1	5.57	5.63	5.59	5.51	5.50	5.50	5.47	5.46
	5.56	5.64	5.50	5.50	5.50	5.49	5.58	5.46
2	5.55	5.65	5.50	5.51	5.51	5.48	5.47	5.46
	5.55	5.61	5.57	5.50	5.50	5.52	5.47	5.58
3	5.55	5.61	5.57	5.50	5.50	5.52	5.47	5.48
	5.56	5.63	5.55	5.50	5.51	5.52	5.48	5.47
4	5.55	5.62	5.55	5.50	5.51	5.51	5.48	5.46
Total	44.46	45.01	44.41	44.04	44.03	44.05	43.80	43.71
Mean	5.56	5.63	5.55	5.51	5.50	5.50	5.47	5.46

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Treatment	7	0.2234	.03187	61.76	2.43	3.50
Pots within treatment	24	.0552	.00230	230.0	1.86	2.42
Determination within the pot	32	.0003	.00001			
Total	63	.2786				

L.S.M.D. = 0.05

TABLE 3

Organic matter of the soil in per cent during the booting stage of the rice plants

REPLICATION	TREATMENT							
	I	II	III	IV	V	VI	VII	VIII
	3.48	3.44	3.47	3.48	3.48	3.45	3.56	3.50
1	3.48	3.41	3.48	3.48	3.48	3.46	3.51	3.51
	3.48	3.46	3.55	3.44	3.44	3.55	3.41	3.51
2	3.55	3.48	3.50	3.45	3.46	3.53	3.44	3.55
	3.55	3.45	3.45	3.47	3.62	3.48	3.52	3.53
3	3.55	3.42	3.48	3.48	3.55	3.48	3.53	3.52
	3.55	3.54	3.48	3.44	3.44	3.45	3.44	3.58
4	3.55	3.52	3.48	3.45	3.45	3.48	3.42	3.62
Total	28.19	27.72	27.89	27.69	27.89	27.88	27.83	28.36
Mean	3.52	3.46	3.48	3.46	3.46	3.48	3.48	3.54

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Treatment	7	0.0462	0.0066	1.70	2.43	3.50
Pots within treatment	24	0.0928	0.0039	9.92	1.86	2.42
Determination within the pot	32	0.0126	0.0004			
Total	63	0.1506				

TABLE 4

Total nitrogen content of the soil in per cent during the booting stage of the rice plants

REPLICATION	TREATMENT							
	I	II	III	IV	V	VI	VII	VIII
	.145	.141	.152	.150	.156	.150	.152	.157
1	.141	.143	.154	.150	.157	.148	.150	.156
	.142	.142	.152	.149	.158	.147	.153	.157
2	.141	.142	.151	.148	.157	.149	.150	.155
	.152	.141	.150	.147	.157	.148	.152	.158
3	.141	.142	.150	.148	.157	.147	.150	.157
	.145	.142	.155	.150	.159	.150	.152	.158
4	.142	.142	.154	.150	.157	.149	.152	.155
Total	1.139	1.135	1.218	1.192	1.258	1.188	1.211	1.253
Mean	.142	.142	.152	.149	.157	.148	.151	.156

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Treatment	7	0.001846	0.000263	88.66	2.43	3.50
Pots within treatment	24	0.000050	0.000002	1.45	1.86	2.42
Determination within the pot	32	0.000044	0.0000013			
Total	63	0.001940				

L.S.M.D. = 0.002

TABLE 5

Available phosphorus content of the soil in ppm. during the booting stage of the rice plants

REPLICATION	TREATMENT							
	I	II	III	IV	V	VI	VII	VIII
	9.2	9.2	6.0	6.0	8.4	6.0	8.4	18.0
1	9.6	7.6	8.4	12.0	12.4	11.0	11.6	22.2
	10.2	10.2	9.0	12.4	9.2	10.2	9.6	19.6
2	8.0	9.6	10.2	12.0	11.0	9.6	12.0	17.0
	7.6	10.2	8.4	6.0	9.2	13.5	8.4	19.6
3	7.6	7.6	8.4	8.4	8.4	9.6	13.5	18.0
	12.4	11.6	11.6	13.6	13.5	13.5	11.6	22.2
4	8.4	8.4	9.6	11.6	11.6	9.6	12.0	18.0
Total	73.0	74.4	71.8	82.0	83.7	83.0	87.1	154.6
Mean	9.12	9.30	8.98	10.25	10.46	10.38	10.88	19.33

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Treatment	7	460.35	65.76	5.42	2.43	3.50
Pots within treatment	24	291.20	12.13	3.0	1.86	2.42
Determination within the pot	32	129.52	4.04			
Total	63	881.07				

L.S.M.D. = 3.51

TABLE 6

Exchangeable potassium of the soil in ppm. during the booting stage of the rice plants

REPLICATION	TREATMENT							
	I	II	III	IV	V	VI	VII	VIII
	58.0	100.6	40.6	30.2	32.0	29.6	29.0	29.0
1	56.4	100.6	40.6	30.0	32.0	29.0	35.0	32.0
	58.0	89.6	40.0	32.0	32.0	27.6	30.0	34.0
2	53.6	87.2	41.0	26.0	30.4	22.0	29.6	32.0
	56.2	100.0	40.0	32.0	29.0	24.0	32.0	29.0
3	58.0	100.0	40.4	32.0	32.0	26.0	32.0	32.0
	53.6	89.6	38.0	29.0	29.0	27.6	32.0	30.6
4	58.6	89.6	44.0	24.0	32.0	29.0	27.0	29.0
Total	452.4	757.2	234.6	235.2	284.4	214.8	246.6	247.6
Mean	56.55	94.65	40.57	29.40	31.05	26.85	30.85	30.95

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Treatment	7	29,903.57	4,271.98	301.5	2.43	3.50
Pots within treatment ...	24	350.27	14.59	3.13	1.86	2.42
Determination within the pot	32	149.04	4.66			
Total	63	30,402.88				

L.S.M.D. = 3.96

TABLE 7

Mean height and number of bearing culms of the rice plants at maturity

LOT	HEIGHT	BEARING CULMS
	cm.	
I	117.50 ± 6.28	10.0 ± 1.78
II	107.50 ± 4.68	6.0 ± 0.71
III	147.50 ± 4.78	17.2 ± 1.51
IV	137.50 ± 2.50	25.5 ± 5.48
V	140.00 ± 4.08	26.0 ± 6.06
VI	155.00 ± 2.88	22.2 ± 4.21
VII	142.50 ± 7.61	17.7 ± 1.12
VIII	140.00 ± 4.08	27.7 ± 5.17

TABLE 8

Weight of filled grains in grams

LOT	REPLICATION				TOTAL	MEAN
	1	2	3	4		
I	7.01	27.50	43.18	17.11	94.80	23.7
II	6.19	9.19	8.54	12.85	36.77	9.2
III	53.22	46.37	46.40	48.99	194.98	48.7
IV	81.00	30.92	53.66	41.49	247.07	61.8
V	86.85	35.70	49.03	63.43	235.01	58.8
VI	48.45	33.20	60.80	68.65	211.10	52.8
VII	35.12	41.85	52.00	33.16	162.13	40.5
VIII	65.79	57.30	43.96	33.28	200.33	50.1

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Treatment	7	9,201.20	1,314.46	5.69	2.43	3.50
Pots within treatment	24	5,537.21	230.72			
Total	31	14,738.42				

L.S.M.D. = 22.2

TABLE 9

Weight of straw in grams

LOT	REPLICATION				TOTAL	MEAN
	1	2	3	4		
I	130.0	36.0	65.0	35.0	266.0	65.0
II	17.0	29.0	32.0	25.0	103.0	25.0
III	130.0	134.0	128.0	128.0	520.0	130.0
IV	139.0	110.0	102.0	139.0	490.0	122.0
V	123.0	105.0	115.0	136.0	479.0	119.7
VI	160.0	130.0	125.0	114.0	529.0	132.0
VII	138.0	177.0	72.0	68.0	455.0	113.0
VIII	128.0	125.0	147.0	108.0	508.0	127.0

Analysis of variance

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					5%	1%
Treatment	7	40,856.00	5,836.57	7.74	2.43	3.50
Pots within treatment	24	18,094.88	753.95			
Total	31	58,950.88				

L.S.M.D. = 40.1

TABLE 10

Mean grain weights, percentage loss in weight after sun-drying, percentage of empty grains and ratio of grain to straw

LOT	WEIGHT OF GRAIN						STRAW	GRAIN TO STRAW RATIO
	Fresh	Sun-dried	Loss [a]	Oven-dried	Empty	Empty [b]		
	grams	*grams*	*per cent*	*grams*	*grams*	*per cent*	*grams*	
I	34.00	30.55	10.12	23.70	4.17	14.96	65.0	1:2.74
II	11.66	10.65	8.66	9.19	0.59	6.03	25.0	1:2.72
III	66.75	56.87	14.80	48.74	4.23	7.98	130.0	1:2.66
IV	85.62	76.12	11.09	61.77	6.42	9.41	122.0	1:1.97
V	78.37	70.12	10.52	58.75	11.96	16.91	119.7	1:2.03
VI	70.75	62.62	11.49	52.77	3.93	6.93	132.0	1:2.50
VII	57.62	47.50	17.56	40.53	3.00	6.89	133.0	1:2.78
VIII	76.75	66.62	13.19	50.08	9.53	15.99	127.0	1:2.53

[a] Loss of weight in per cent $= \frac{\text{fresh weight} - \text{sun-dried weight}}{\text{fresh weight}} \times 100.$

[b] Empty grains in per cent $= \frac{\text{empty}}{\text{empty} + \text{oven-dried}} \times 100.$

WAREHOUSES AND RICE MILLS IN SOME TOWNS OF NUEVA ECIJA [1]

FELINO B. ROMANO

Thirteen towns in Nueva Ecija had 33 bonded and unbonded warehouses owned by Chinese and Filipinos, in addition to the 14 warehouses operated by the NARIC. The Chinese operators had been engaged in the warehousing business for an average of 8.9 years; the Filipinos, 4.5 years.

The average maximum amount that could be stored at a time in a Chinese-operated warehouse was 37,454 cavans, and in a Filipino-operated warehouse, 15,454 cavans. The NARIC warehouse could store an average of 130,000 cavans using the Japanese piling system or 157,500 cavans using the Chinese system.

Most of the palay was taken in from December to June and released from May to October or the early part of November. A large proportion of the palay was bought by buyers and dealers. A shrinkage allowance was computed for every cavan of palay stored in the warehouses. The warehouse owners provided their depositors with free facilities including transportation, scales, sacks, and labor for hauling. The average number of laborers employed by a Chinese warehouse operator was 10; by a Filipino operator, 8; and by the NARIC, about seven.

The "kiskisan," bonded warehouse, and "cono" type rice mill paid separate and fixed quarterly municipal taxes and a business tax based on the amount and value of palay milled. A "kiskisan" did not pay any business tax if it did not mill a minimum of 200 cavans for every quarter of the year. Eleven Chinese had the "cono" type rice mills and two had the "kiskisan" type. Ninety-five Filipinos had the "kiskisan" type; 18 had the "cono" type; and four operated bonded warehouses. "Kiskisan" mills were mostly owner-operated. In the city of Cabanatuan, the operator paid a fixed tax of ₱15 on a quarterly basis and a 3 per cent business tax.

Warehousing, milling, and financing are essential services in the marketing of rice. It is maintained frequently that these three services in the Philippines are controlled by aliens and that the charges are excessive. The problem of inadequate marketing facilities was recognized with the enactment of Republic Act 821, which created the Agricultural Credit and Cooperative Financing Administration to promote effective marketing of agricultural commodities, especially rice. Reliable information on the marketing situation in rice-producing areas is needed by the administration and by the farmers as a basis for improving marketing facilities and procedures. The business operations of warehouses and rice mills in Nueva Ecija were therefore studied to determine how they can be improved. The survey was conducted in the towns of Guimba, Muñoz, San Jose, Cuyapo, Gapan, Talavera, Sto. Domingo, Sta. Rosa, Nampicuan, Cabanatuan

[1] Central Experiment Station Contribution No. 1778. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1954. Prepared in the Department of Agricultural Economics under the direction of Professor L. S. Robertson and Assistant Professor Nathaniel B. Tablante.

City, San Leonardo, Lupao, and Peñaranda from December, 1952, to December, 1953.

Asuncion [2] found that the principal outlet of palay in Nueva Ecija in 1932 was the rice miller. Farmers disposed of nearly one-half of their palay almost immediately after harvest.

Velmonte [3] found that the rice mills provided facilities for storing and financing the greater part of the palay. Some millers handled more palay than the amount authorized them under their license. Buying by the mills was heaviest during the first half of the year. Velmonte further stated that prices of palay steadily increased from April, reaching a peak in September or even as late as November just before the next crop was ready. When prices were most profitable, relatively little palay remained in the hands of the farmers.

METHOD OF STUDY

A list of all rice mill and warehouse owners in the 13 towns of Nueva Ecija was obtained from the offices of the provincial treasurer and the municipal treasurer. The list also showed the taxes, classification, location, and year of establishment of the rice mills and warehouses. The owners were asked a standard set of questions. Local farmers, retailers, buyers, middlemen, and municipal treasurers were also interviewed to obtain pertinent information.

RESULTS AND DISCUSSION

Warehouses

Number of warehouses. In addition to the 14 warehouses operated by the National Rice and Corn Corporation in four of the 13 towns, there were 33 bonded and unbonded warehouses at the time of the survey. Eleven of them, seven bonded and four unbonded, were owned by Chinese, and 22, 12 bonded and 10 unbonded, were owned by Filipinos.

Length of operator's warehousing experience. The warehousing experience of the Chinese and Filipino operators is shown in table 1. One Chinese and two Filipinos had relatives who were also in the warehousing business. All the operators, both Chinese and Filipino, had built their own warehouses.

Description of warehouses. The warehouses included in the survey are described in table 2. Five Chinese had more than one warehouse. All the Filipinos had one warehouse each. The percentage of buildings destroyed during the war was 46 for the Chinese owners, 25 for the NARIC, and zero for the Filipinos.

Most of the warehouses had galvanized iron walls and roofs. One was walled with sawali. In warehouses without partitions a part of the room was used for an office. Galvanized iron doors were

[2] D. F. Asuncion, *Philippine Agriculturist*, 21, 177 (1932).
[3] J. E. Velmonte, *Philippine Agriculturist*, 25, 382 (1935).

the most common. Many of the warehouses were located near the national road.

The NARIC warehouses were very much larger than the others. The Filipino-operated warehouses averaged more than twice the Chinese-operated ones in terms of cubic meters of space, but more palay could be stored at any one time in the Chinese warehouses because of a better piling arrangement.

As estimated by the owners the current value of warehouses was higher than the original cost, regardless of physical depreciation, because of the increase in cost of construction.

Capacity and use of warehouse. The maximum amount that could be stored at a time ranged from 10,000 to 175,000 cavans, or an average of 37,454 cavans, in Chinese-operated warehouses and from 10,000 to 40,000 cavans, or an average of 19,727, in Filipino-operated warehouses. The NARIC used the Japanese and Chinese piling arrangements. With the Japanese arrangement, the maximum capacity ranged from 90,000 to 160,000, or an average of 130,000 cavans, and with the Chinese arrangement, from 120,000 to 180,000 cavans, or an average of 157,500 cavans.

Warehouses received and released some palay every month (table 3). They took in much more than they released from December to May and released much more than they took in during the remainder of the year as shown below:

	CHINESE		FILIPINO	
	Net storage	Net release	Net storage	Net releasé
	(In thousand cavans)			
January	25	—	13	—
February	16	—	10	—
March	11	—	7	—
April	2	—	2	—
May	—	—	—	1
June	—	—	—	1
July	—	15	—	7
August	—	18	—	8
September	—	23	—	10
October	—	21	—	11
November	—	2	—	6
December	26	—	14	—
	80	79 [a]	46	44 [a]

[a] Difference does not include quantity at the beginning and at the end of the year.

The NARIC warehouses did only a little business during the year of the survey. Most of the palay they took in for storage came from the main warehouse in Manila. A few cavans, however, were bought from farmers and rice millers.

Deposits and disposal of palay. Deposits of palay were made largely by buyers and dealers who borrowed money from the warehouse operators and went to the barrios, as far away as Isabela and

Nueva Vizcaya, to buy rice from March to May. Table 4 shows that most of the deposits of these buyers and dealers were not withdrawn by them, but were purchased by the warehouse operators. For the small percentage of deposits not handled in this way, a shrinkage allowance was computed, the amount depending on the number of months of storage. A fee was also charged for each cavan of palay withdrawn.

Table 5 shows the average purchases from different sources. The buyers and dealers supplied most of the palay for milling and sold either at retail or wholesale or both.

Terms of warehousing. Prices offered by the NARIC at the time of deposit and even at the time of withdrawal were the same, but a shrinkage allowance was computed depending on the length of storage (table 6). The basic weight was 46 kilograms in December and January, 45 kilograms in February, and 44 kilograms from March to November. Thus, if a man deposited 100 cavans weighing 46 kilograms each in December and withdrew them any time from March to November, the basic weight of each cavan at the time of withdrawal would be 44 kilograms, a shrinkage of 2 kilograms. The number of cavans withdrawn would still be 100, but the weight of each cavan would be considered 44 kilograms.

All of the warehouse operators deducted from 1 to 2 kilograms from a cavan for shrinkage, regardless of the number of days it was in storage (table 6). If withdrawn, an average fee of ₱0.13 among Chinese and ₱0.12 among Filipinos was charged. In the NARIC, an average storage fee of ₱0.10 was charged, regardless of whether the palay was withdrawn or not.

Depositors in Filipino and Chinese warehouses who did not want to pay the "liquidacion" charge [4] at the time of withdrawal delegated somebody who was not known to the operator to ask for the price offered for the day and later show the operator the warehouse tally sheet. In this way no charge was made, for the operator could no longer lower the price, thinking that the person was a prospective seller.

Facilities provided for depositors. The warehouse owners provided their depositors with all the facilities they had free of charge (table 7). If a seller came in a *calesa* or a *caretela,* the fare for every cavan of palay was paid by the warehouse to attract farmers selling in small quantities. If the cavans were too many to be loaded in a cart, the seller could borrow sacks from any warehouse operator and get transportation free of charge.

Warehouse operators did not wholly operate by *buhos,* a Tagalog word literally meaning "to pour." *Buhos* was made only at the time the palay was bought. Later, the palay was sacked for further drying. Not all the operators bought new sacks every time; instead, they mended their old sacks. The duration of a sack was one to two years depending on how often it was used. Warehouse

[4] *Ibid.*

operators believed that good milling and warehousing require the use of good sacks.

Either Fairbanks-Morse scales or Howe scales were used. The scales were never sent to the field by warehouse operators; weighing was always done at the warehouse.

No mechanical driers were used because a long dry season followed the harvest and the heat from the galvanized iron roofs and walls of the warehouses tended to keep the palay dry.

With the use of a "bureki," a cylindrical pointed instrument inserted into the sack to bring out samples, warehouse operators could determine whether the palay in the sacks was thoroughly dry or not. It was also used to detect the amount of dirt or dust mixed with the palay. When the palay was found to be wet or dirty, corresponding deductions in weight were made.

Labor force. Only one Filipino and two Chinese warehouse operators had *serenos* or guards. The NARIC had permanent guards, but only the main branch at the capital had one platoon of guards. The chief guard received ₱180; the sergeant, ₱150; and the private and corporal, ₱102 a month (table 8).

Some Chinese warehouse operators paid their mechanics on a monthly basis. Two kept mechanics on special call and paid them ₱5.00 a day. Six hired their mechanics on a daily basis at ₱4.50 to ₱5.00 a day. Fourteen Filipino operators paid their mechanics a monthly salary of ₱150. One paid ₱120 a month; three, from ₱4.50 to ₱5.00 a day; and one, on a percentage basis.

The average number of laborers employed by Chinese warehouse operators was 10. One was on a contract basis; the rest were paid ₱120 a month. The Filipino operators had an average of eight laborers. Eighteen paid on a monthly basis at ₱120 a month, three on a contract basis at ₱0.10 a cavan, and one on a 5 per cent basis. Chinese operators paid their bookkeepers an average amount of ₱103 a month. They hired bookkeepers only to prepare the books at the end of the month. Some truck drivers were paid monthly and some were paid for every trip.

Taxes. The internal revenue tax was the same for all warehouses, but the municipal tax varied in different municipalities (table 8). In the city of Cabanatuan, a separate and fixed municipal tax and a separate and fixed quarterly municipal tax on warehouses and on "cono" type rice mills were charged. In addition, a 3 per cent business tax was paid to the municipal treasury. In other places, the business tax was only 2 per cent. This business tax was based on the number of cavans milled. If the price of a cavan of rice was ₱18 and that of a cavan of rice bran was ₱2, the business tax was computed on a total of ₱20. Warehouses did not report all of the business they handled so that the government did not collect as much as it should have collected.

All the warehouses had fire insurance policies. Three Chinese and 11 Filipino warehouses were not bonded. The amount of bond

applied for should limit the number of cavans to be stored in the warehouse, but actually, the warehouse operators exceeded the amounts specified in their bonds.[5] This resulted from too infrequent checks of the books by the municipal treasurer.

Rice mills

"Cono" type mills. Eleven Chinese had the "cono" type rice mills and two had the "kiskisan" type. Ninety-five Filipinos had the "kiskisan" type; 18 had the "cono" type; four had no rice mill of either type but only operated bonded warehouses (table 9).

Only the fine bran, *tiki-tiki,* was removed at the first milling. The rice hull was later remilled and turned into rice bran, dumped, burned, or used as fertilizer. The rice bran was sold on either retail or wholesale basis. The average recovery of palay for milling varied greatly depending on the season of the year (table 10).

Most of the warehouse owners had not heard of the rubber rice huller. One had heard of it but had no intention of using it because the constant changes needed would involve expense and loss of time.

"Kiskisan" or ordinary type mills. All the Filipino "kiskisan" owners were residents of their respective communities and had lived in the Philippines since birth. The two Chinese "kiskisan" owners had been in the Philippines for an average of 16 years and in the rice mill business for an average of 3.5 years. All their mills had been built by them. Six new mills were studied during the year.

Most of the ordinary rice mills were walled with galvanized iron in combination with steel matting, *buho* and split bamboo, sawali, and wood (table 11). Not all the floors were made of concrete, but most of the mills had concrete foundations at the base of the engine. Most of the mills had doors made of galvanized iron and wood. The rest were doorless, but the gates at the entrance were closed at night.

Some of the mills surveyed had operated before the war and for a short period during the Japanese occupation. They were forced to stop because of lack of oil and spare parts.

Mills situated near national roads milled more cavans of palay than those near provincial roads. The "kiskisan" mills did no milling at night. When they milled for 12 hours continuously, the average capacity of an ordinary rice mill was from 116 to 134 cavans.

Some expenses of operation. "Kiskisan" mills which milled only small quantities were mostly owner-operated. Some were operated by persons paid on a monthly or percentage basis depending on the number of cavans milled (table 12). As in the "cono" type rice mills, operators paid an internal revenue tax of ₱10 and a municipal tax which varied in different municipalities. In the city of Cabanatuan, operators paid a fixed tax on a quarterly basis in the amount of ₱15 and a 3 per cent business tax.

[5] *Ibid.*

Nine mills were partly exempted from business taxes for one or two quarters since they did not report having milled the minimum number of 200 cavans. One was exempted for the entire year.

RECOMMENDATIONS

On the basis of the information revealed by this study, the following are recommended for improving rice warehousing and milling:

1. A higher, fixed, and uniform quarterly municipal tax and a uniform 3 per cent business tax should be levied as in the city of Cabanatuan.

2. The business done by bonded warehouses and rice mills should be more closely supervised by municipal and Internal Revenue officials.

3. "Kiskisan" operators should be required to issue invoices so that the amount milled each day will show at the municipal treasury at the end of each month.

4. Shrinkage should be based on reduction from specified basic weights depending on the length of time in storage instead of one to two kilograms being deducted from a cavan regardless of the length of storage.

5. The law that only bonded warehouses may accept deposits for storage should be enforced.

6. Scales should be checked frequently but irregularly to reduce cheating.

7. All rice mills must have a compartment where rice hull may be placed temporarily before being milled into rice bran.

8. Deposits should be withdrawn by persons other than the depositors to do away with withdrawal charges.

TABLE 1

Background of the operators of warehouses in 13 towns in Nueva Ecija, 1952

BACKGROUND	CHINESE	FILIPINOS	NARIC
Years of residence in community	16	[a]	[b]
Years of stay in the Philippines	29	[a]	[b]
Years in warehousing business	8.9	4.5	[b]
Percentage of operators with relatives in warehousing business	9	13	[b]

[a] Since birth.
[b] Government entity.

TABLE 2

Description of warehouses and rice mills in 13 towns in Nueva Ecija, 1952

CHARACTERISTICS OF WAREHOUSE	CHINESE	FILIPINOS	NARIC
Percentage of warehouses with			
Galvanized iron roof	100	100	100
Galvanized iron walls	100	96	100
Single galvanized iron wall	100	96	100
Partition	0	4.7	0
Collapsible iron door	30	—	35
Galvanized iron door	70	100	65
Office in warehouse	100	100	100
Building destroyed and replaced later	46	0	25
Location near national road	82	73	75
Location near provincial road	18	27	25
Shipping by railroad	45	14	25
Average size: [a]			
Length, meters	12	11	30
Width, meters	10	19	34
Height, meters	17	26	42
Cubic meters	2,040	5,434	42,840
Age of warehouse in years	4	4	10
Cash value, pesos	43,454	22,840	281,250 [b]
Estimated current cash value, pesos	49,727	32,727	135,000
Cavans stored at a time	37,454	19,727	112,500
Cavans stored for others during year	1,643	730	2,500

[a] For a single warehouse.
[b] Cost of 2 warehouses included with use of war notes.

TABLE 3

Average number of cavans of palay stored and released monthly by 47 warehouses in Nueva Ecija, 1952

MONTH	CHINESE	FILIPINOS	NARIC
Quantity on hand at beginning of year ..	2,206.6	509.5	1,000.0
Average quantity in storage:			
January	31,295.0	13,810.2	5,503.0
February	26,957.3	10,915.4	33,825.0
March	24,052.0	9,070.2	2,482.1
April	23,402.9	7,892.2	—
May	27,651.3	10,188.1	—
June	23,720.0	7,788.9	—
July	10,239.5	3,031.0	—
August	10,601.3	1,756.5	—
September	8,961.9	2,474.9	98.0
October	9,993.0	3,182.7	309.0
November	9,627.4	2,301.5	228.2
December	33,012.0	14,897.5	1,489.0
Average quantity released:			
January	6,076.4	631.0	151.2
February	10,777.9	1,108.6	1,115.7
March	12,790.3	2,143.4	—
April	20,811.1	5,518.0	—
May	27,620.6	11,198.8	—
June	23,807.4	9,477.9	—
July	25,214.6	9,728.9	—
August	29,407.4	10,407.7	35.7
September	31,504.1	11,930.5	13.5
October	31,107.2	14,245.9	80.7
November	12,188.8	7,628.9	39.5
December	6,713.4	971.6	5.0
Quantity on hand at end of year	3,701.0	2,827.4	13,493.0

TABLE 4

Percentages of stored palay deposited by various types of depositors,[a] withdrawn by depositors, and purchased by warehouses in 13 towns in Nueva Ecija, 1952

PERCENTAGE OF PALAY	CHINESE	FILIPINOS	NARIC
Deposited by			
Producers	5	16	14
Buyers and dealers	63	52	46
Rice millers	10	17	21
Other warehouse operators	22	15	19
Withdrawn by			
Producers	—	3.8	—
Buyers and dealers	—	0.6	—
Rice millers	—	—	—
Other warehouse operators	0.9	—	—
Purchased by warehouse from			
Producers		—	
Buyers and dealers	90.9	91	75
Rice millers	—	9	—
Other warehouse operators	1.6	—	—

[a] Withdrawals and purchases did not add to deposits because of changes in inventories.

TABLE 5

Purchase and disposal of palay by warehouses in 13 towns in Nueva Ecija, 1952

PURCHASE AND DISPOSAL OF PALAY	CHINESE	FILIPINOS	NARIC
	per cent	*per cent*	*per cent*
Source of purchase:			
Producers	21	30	28
Buyers and dealers	47	47	26
Rice millers	9	12	20
Other warehouse operators	22	15	13
Others	1	4	13
Disposal:			
Milled by warehouse	100	81	27.5
Sold as rice at warehouse	18	38	35.2
Trucked	82	62	64.8
Terms of sale:			
Wholesale and retail	27	5	10
Retail only	36.5	9	45
Wholesale only	36.5	86	45

TABLE 6

Terms of warehousing in 13 towns in Nueva Ecija, 1952

ITEM	CHINESE	FILIPINOS	NARIC
Warehouses without storage fees, per cent	72	64	—
Warehouses with storage fees, per cent	28	36	100
Warehouses determining price at time of withdrawal, per cent	100	95	—
Warehouses paying deposit price at time of withdrawal, per cent	—	—	100
Warehouses giving depositor receipt, per cent	100	100	100
Average range for shrinkage allowance, kilograms	1–2	1–2	—[a]
Average fee charged if deposit is withdrawn, centavos	13	12	10[b]

[a] Varied according to month of withdrawal. Basic weight of a cavan of palay was 46 kilograms in December and January, 45 kilograms in February, and 44 kilograms from March to November.

[b] Charged regardless of whether the palay was withdrawn or not.

TABLE 7

Facilities provided for depositors by warehouses in 13 towns in Nueva Ecija, 1952

ITEM	CHINESE	FILIPINOS	NARIC
Warehouses furnishing sacks, per cent	63	68	100
Warehouses using sacks only for farms owned, per cent	—	5	—
Warehouses furnishing transportation, per cent	73	95	—
Average cost of new sacks, pesos	70	64	90
Average cost of old sacks, pesos	45	35	38
Average number of sacks bought last year	7,454	3,738	16,500
Average number of years sacks will last	1.4	1.4	1.8
Average number of vehicles owned	2	1.6	—
Average number of scales owned	2	2	14
Proportion of purchased palay hauled by warehouse transportation	58	58	50
Proportion of sold palay hauled by warehouse transportation	54	46	55
Average capacity of scales, kilograms	1,645	1,011	1,000

TABLE 8

Average expenses incurred in operating warehouses in 13 towns in Nueva Ecija, 1952

ITEM	CHINESE	FILIPINOS	NARIC
	pesos	*pesos*	*pesos*
Labor:			
Guards	130	120	150 [c]
Mechanics	130 [a]	150	—
Bookkeepers	103	100	175
Truck drivers	127	120 [b]	108
Laborers	120	120	103
Taxes:			
Land	43	86	656
Business	5,074	2,863	—
Internal revenue	10	10	—
Municipal	63	57	—
Fire insurance	5,370	2,614	—
Investments:			
Sacks	5,218	2,391	14,850
Rentals	11,650	1,181	—
Buildings	43,454	22,840	281,250
Machinery	62,142	39,139	48,700
Transportation	8,900	9,522	—
Scales	876	869	840
Bonds	64	68	—

[a] Two on special call at ₱5 a day, 6 on daily basis at ₱4 to ₱5 a day.
[b] One on contract basis.
[c] One at ₱5 a trip.

TABLE 9

Characteristics of rice mills in 13 towns in Nueva Ecija, 1952

ITEM	CHINESE	FILIPINOS	NARIC
Percentage of warehouses with "cono" type rice mills	100	83	75
Percentage of warehouses with "kiskisan" type rice mills	—	4	—
Percentage of warehouses with no rice mill of either type	—	17	25
Average value of "cono" rice mill, pesos	39,454	39,139	48,700
Average years since mill was purchased	4	5.3	2.5
Average number of cavans milled in 24 hours	409	482	—
Average number of days mill was used	269	267	120
Percentage of warehouses milling for others	82	82	—
Average charge a cavan milled, pesos	1.00	.88	—
Average years the mill is expected to last	62	54	35

TABLE 10

By-product turnover and disposal in rice mills in 13 towns in Nueva Ecija, 1952

ITEM	CHINESE	FILIPINOS	NARIC
Mills milling hull for feed, per cent	63	59	25
Mills selling, per cent:			
Retail	54	63	25
Wholesale	45	37	25
Mills using hull fertilizer, per cent	9	—	—
Mills dumping hull, per cent	90	59	4
Mills burning hull, per cent	36	9	25
Mills selling rice bran to others, per cent	9	72	25
Mills mixing binlid, per cent	0.6	0.2	—
Average cost range of rice bran, centavos	.04–.15	.02–.15	.05–.15 [a]
Number of kilograms of rice bran from a cavan of palay milled	3.4	3.5	1.5
Number of kilograms of binlid from a cavan of palay milled	1.5	1.2	25
Average recovery, per cent	51	51	76

[a] ₱2.10 to ₱6.75 a cavan.

TABLE 11

Description of "kiskisan" mills in 13 towns in Nueva Ecija, 1952

FEATURE	CAVANS MILLED DURING YEAR				
	458-211	640-500	875-650	3100-956	6789-3500
Percentage of mills with					
Walls: [a]					
Galvanized iron	46	57	73	70	87
Wood	3.8	4	—	25	—
Others	61	43	31	15	13
Floor:					
Concrete floor	26	33	22	65	100
Concrete foundation	74	67	78	35	—
Wood	—	—	—	—	—
Others	50	14	21	—	—
Doors:					
Galvanized iron	47	38	26	60	87
No door	—	31	—	25	13
Others	0	0	0	0	0
Wood	53	31	74	15	0
Iron	—	—	—	—	—
Destroyed during war	8	24	90	20	—
Located near national road	34	52	47	65	88
Located near provincial road	66	48	53	35	12
Size:					15
Length, meters	14	15	14.2	13.8	
Width, meters	7.7	8.7	7.8	8	8.5
Height, meters	13.0	12.0	12.1	13.2	13.6
Cubic meters	1401	1566	1339	1457	1734
Average years constructed	6.3	6.5	6.2	4.7	4
Cost of mill and building	7401	6650	7228	8175	8358
Present estimated value	9192	8786	8868	9225	8875
Years mill will last	45	44	50	52	53
Years in rice mill business [b]	6.4	6.5	6.6	4.9	4
Cavans milled last year	342	572	724	1591	5472
Cavans milled in 12 hours	116	134	125	132	127
Gantas of rice for every cavan of palay milled	11.2	11.3	11.0	11.0	11.3
Gantas of rice bran for every cavan of palay milled	13.6	12.5	13.6	13.9	13.6
Charge for a cavan of palay milled, centavos	43	42	44	41	40

[a] Figures total more than 100 in some groups because some mills had more than one kind of wall.

[b] Since first registered.

TABLE 12

Some operating expenses of "kiskisan" mills according to number of cavans milled annually

ITEM	CAVANS MILLED DURING YEAR				
	458-211 and below	640-500	875-650	3100-956	6789-3500
Wages [a]	120	120	150	117.50	120
Taxes:					
Land	12	18	19	20	20
Municipal	12	13	11	23	11
Business	8	17	24	43	168
Internal revenue	10	10	10	10	10
Machinery and equipment maintenance [b]	1750	1410	1350	2750	

[a] Does not include payment on percentage basis or cavan basis.
[b] Investment rather than annual cost.

OUTSTANDING VARIETIES AND FORMS OF PUMMELO, CITRUS GRANDIS (LINN.) OSBECK, IN SOME TOWNS OF BATANGAS [1]

CELSO E. HERMOSO AND L. G. GONZALEZ

WITH ONE TEXT FIGURE

The selected varieties of pummelo were ranked according to sweetness by a panel of judges as follows: (1) Fortich, (2) Amoy, (3) Tai Tao, (4) Siamese Pink No. 2, (5) Siaver, and (6) Siam, the control. Based on sugar-acid ratio, the order of the varieties was as follows: (1) Fortich, (2) Siamese Pink No. 2, (3) Amoy, (4) Tai Tao, (5) Siaver, and (6) Siam. All the selected varieties, therefore, were superior to the Siam variety, which is predominantly cultured in the commercial citrus orchards of Batangas.

The pummelo (*C. grandis* [Linn.] Osbeck) is one of the most popular members of the citrus species in the Philippines, but very little has been done towards its improvement. Most of the pummelos sold in our markets, particularly in Manila, are imported from China.

Galang [2] stated that pummelos grown in the Philippines are poorer in quality than the imported varieties. Webber [3] reported that pummelos of high quality are produced only in restricted areas and under particular conditions. De Leon [4] mentioned that locally produced fruits are inferior in quality to the imported varieties sold in our markets at exorbitant prices because of the old practice of growing pummelos from seeds rather than from budded plants from choice varieties.

To uncover forms and varieties of pummelo that can meet market requirements and stand competition with imported varieties, a survey was made in some towns of Batangas from December, 1952, to February, 1954.

MATERIALS AND METHODS

Different towns in Batangas were visited for samples of good pummelos. Facts about the history and performance of the trees and other pertinent information were obtained from the owners. From five to seven fruits were picked from each of the 10 best trees that were found. These fruits were packed and marked carefully

[1] Central Experiment Station Contribution No. 1779. Taken from the thesis presented by the senior author for graduation with the degree of Bachelor of Science in Agriculture, April, 1954. Prepared in the Department of Agronomy under the direction of the junior author.

[2] F. G. Galang, *Dept. Agric. and Nat. Resources Bull.*, 13 (1947).

[3] H. J. Webber and L. D. Batchelor, "Citrus Industry," University of California, Berkeley and Los Angeles, 1948, Vol. 1, 1028 pp.

[4] J. De Leon, *Dept. of Agric. and Nat. Resources Bull.*, 40 (1951).

for identification before they were brought to the College of Agriculture for laboratory study.

The fruit samples were studied in detail. The weight and measurement of each fruit were taken carefully. The number of segments, thickness and color of rind, color of contents, and other fruit characteristics were also noted.

One fruit each of the 10 selected varieties was subjected to chemical analysis.[5] The fruits were individually analyzed to determine the juice-pulp ratio, amount of titratable acidity,[6] and sugar content of the juice.[7] The Siam pummelo was used as control.

RESULTS AND DISCUSSION

Table 1 lists the 10 varieties and forms of pummelo that were selected from 42 trees. The varieties were arranged according to their eating quality from the best to the poorest as follows: (1) Fortich, (2) Amoy, (3) Tai Tao, (4) Siamese Pink No. 2, (5) Siaver, (6) Siam (control), (7) seedling variety owned by Dr. Alfredo Marasigan, (8) seedling variety owned by Mr. Tomas Mallangbayan, (9) seedling variety owned by Mr. Porfirio Lindog, and (10) seedling variety owned by Mr. Ruperto Gumapac. For more detailed pomological analysis and chemical analysis of the juice for total reducing sugar and titratable acidity, the selection was narrowed down to six varieties (fig. 1).

The fruits differed significantly in measurement (table 2), weight (table 3), thickness and weight of rind (tables 4 and 5), number of segments (table 6), weight of rag (table 7), number and weight of seeds (tables 8 and 9), and percentage of edible portion (table 10).

Table 11 gives the titratable acidity of the fruits in milliliters of 10/N NaOH per 100 ml. of undiluted juice. For more accurate evaluation, perhaps the values should be expressed in terms of citric acid. Highly significant differences were obtained in the sugar contents of Fortich and Amoy, for both possessed the least amounts of acid.

In amount of total reducing sugar, highly significant differences were obtained. An L.S.M.D. of 3.84 made the difference between the fruits of any two trees significant (table 12).

The data presented in table 13 indicate differences in juice-pulp ratio among the fruits studied. The juice-pulp ratio helps give a better evaluation not only of the juiciness of the fruits but, to some extent, also of their texture.

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[5] Chemical analyses of the fruits were done under the supervision of Professor Leopoldo Villanueva, Department of Agricultural Chemistry.

[6] None of the pH meters in the College was in operation when this work was done, and determination by colorimetric method was not considered accurate enough to be useful.

[7] After AOAC, "Methods of Analyses of the Association of Agricultural Chemists," 1945, sixth edition.

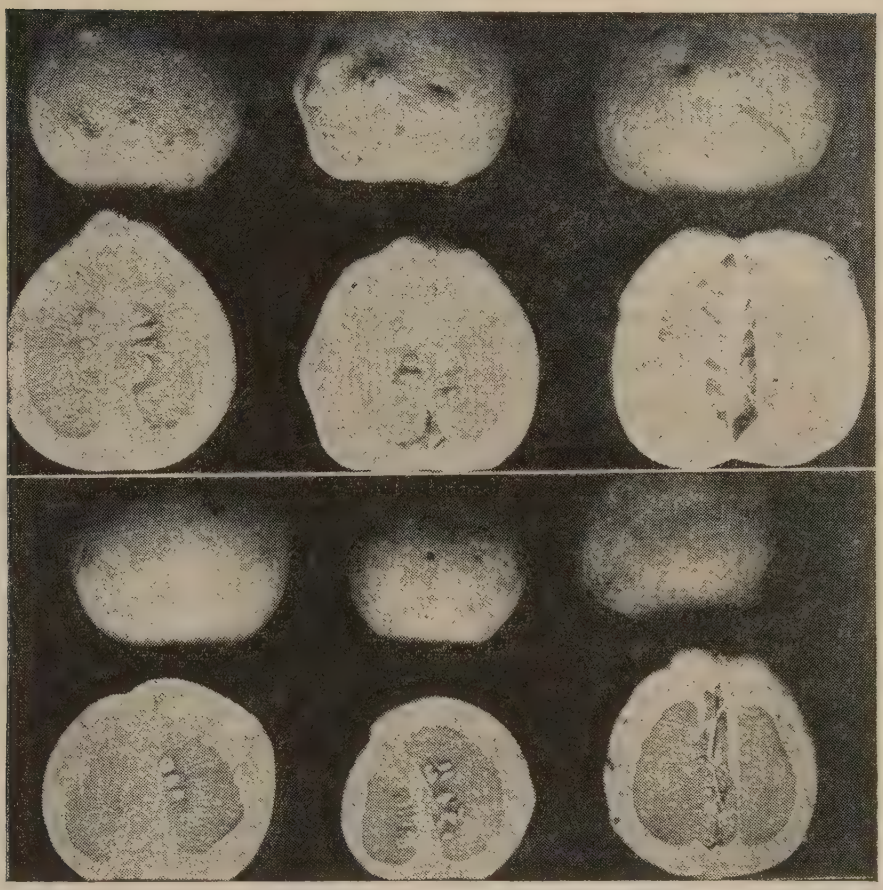

Fig. 1.—Shapes and longitudinal cross sections of some of the outstanding varieties of pummelo in the province of Batangas: upper panel, from left to right, Siam, Siamese Pink No. 2, and Siaver; lower panel, in the same order, Tai Tao, Fortich, and Amoy.

The ranking of the fruits made by a panel of judges almost tallied with the results of chemical analysis based on sugar-acid ratio (table 14). According to both methods, Fortich was first, Siaver was fifth, and Siam was sixth. Amoy was placed second by the judges and was third in chemical analysis. Tai Tao was ranked third by the judges, but was fourth in chemical analysis. Considering the size of error involved in each method, a combination of the two would give a more satisfactory measure of eating quality. Either method may be good enough for preliminary work in evaluating taste of pummelo fruits.

It should be pointed out that in the market, the Siam pummelo, which is inferior to Fortich, Amoy, Tai Tao, Siamese Pink

No. 2, and Siaver, is already considered superior to local varieties. The popularization, therefore, of any of the five varieties selected in this study would be a decided improvement in pummelo growing.

All the varieties selected were from the Lipa Citrus Experiment Station. Their pomological descriptions follow:

Tai Tao was introduced into the Philippines in 1935 from China. The tree is a heavy yielder and is resistant to canker. The fruits are ovoid and mature from December to January. The rind is smooth, easy to peel, thin, and very light pink underneath. The flesh is fine-textured, good-flavored, and moderately seedy. The difference between the average sugar content of its juice and that of the control is highly significant (table 12). The acidity of the variety is significantly lower than that of the control (table 11).

Siaver is a hybrid between the Siam and the Vermilion pummelo. The tree is a regular and fair yielder and is fairly resistant to common diseases. The rind is yellowish. The flesh is easily separable and is of fair texture and excellent flavor. It is moderately seedy. Its acidity is significant when compared to that of the control (table 11). The sugar content is also significantly different from that of the control (table 12).

Amoy, according to De Leon,[8] was introduced in 1932 from Canton, China. The fruit is round to oblong and medium in size. The rind is medium thick and pinkish underneath. The flesh is soft-textured and fairly juicy so that it does not drip when eaten. Its color is pale and it has a sweet pleasant flavor. The seeds are few. The tree is a good grower and is a productive and regular bearer. The acid content of the juice is significantly lower than that of the control (table 11).

Siam was introduced from Siam where it is called Kao Phuang. It is pyriform, medium to large in size with a thin rind. Its flesh is rather colorless, very juicy, and soft-textured, and it has a sweet subacid flavor. The variety has none or many seeds depending, it is believed, upon whether it is cross-pollinated with other varieties or not. The tree is fairly productive under favorable conditions. Its principal defect is its high susceptibility to citrus canker. The variety has not proved well-adapted to the altitude of Lipa, Batangas. At lower altitudes, however, it has produced fruits of better quality and appearance.

Fortich was taken from the home orchard of Don Manuel Fortich at Impalotao, Bukidnon. It is one of the best Philippine pummelos. Its fruit is round, medium-sized, with a whitish flesh that is soft-textured, easily separated from its envelope, and excellently flavored. Its juice is fairly abundant and does not drip when the fruit is eaten. The seeds are many. The tree is fairly productive and resistant to canker. The sugar content of the Fortich pummelo is highly significant over that of the control (table 12), but its acidity is significantly lower (table 11).

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[8] De Leon, *op. cit.*

Siamese Pink No. 2 is one of the most promising pummelo crosses. It is medium to large, is round, and has a medium-thick rind which is pinkish underneath. The flesh easily separates, is soft-textured, and is of excellent flavor and long keeping quality. It is productive, is a regular bearer, and is resistant to canker. Its sugar content is highly significant over that of the control (table 12), but its acidity is significantly lower than that of the control (table 11).

TABLE 1

Ten selected varieties and forms of pummelo, their owners, and their locations

TREE NO.	VARIETY AND OWNER	LOCATION
I	Amoy	Lipa Citrus Experiment Station
II	Fortich	" " " "
III	Siam	" " " "
IV	Siamese Pink No. 2	" " " "
V	Siaver	" " " "
VI	Tai Tao	" " " "
VII	Tree owned by Porfirio Lindog	San Felipe, Pedro Garcia, Batangas
VIII	Tree owned by Ruperto Gumapac	Boot, Tanauan, Batangas
IX	Tree owned by Tomas Madlangbayan	Cuenca, Batangas
X	Tree owned by Alfredo Marasigan	San Juan, Batangas

TABLE 2

Length × width of fruits in centimeters

FRUIT NO.	NUMBER OF TREE									
	I	II	III	IV	V	VI	VII	VIII	IX	X
1	13.5 × 12.5	12.5 × 12.0	15.0 × 12.5	15.3 × 15.0	14.9 × 15.5	12.0 × 13.2	13.2 × 13.4	15.2 × 15.0	13.6 × 12.4	13.4 × 14.2
2	15.0 × 14.0	9.5 × 9.4	15.4 × 11.8	13.7 × 14.0	16.4 × 15.9	12.2 × 13.1	13.1 × 12.8	14.8 × 15.3	15.4 × 15.1	13.2 × 14.3
3	15.3 × 15.0	12.0 × 11.1	15.2 × 12.3	14.2 × 14.4	15.2 × 15.8	13.1 × 14.4	14.0 × 14.1	15.0 × 15.4	15.0 × 14.8	13.0 × 14.3
4	13.3 × 14.5	12.0 × 11.9	15.4 × 11.7	14.8 × 14.7	15.6 × 15.8	12.9 × 15.0	13.8 × 14.2	14.7 × 14.9	15.2 × 14.1	13.3 × 14.5
5	15.2 × 14.8	12.3 × 11.2	14.9 × 11.2	14.4 × 14.4	15.3 × 15.6	12.4 × 15.6	13.7 × 13.9	14.9 × 15.3	15.1 × 14.7	13.4 × 14.6
Mean	14.5 × 14.2	11.7 × 11.1	15.2 × 11.9	14.5 × 14.5	15.5 × 15.7	12.5 × 14.3	13.6 × 13.7	14.9 × 15.2	14.9 × 14.2	13.3 × 14.4

TABLE 3

Weight of fruits in grams

FRUIT NO.	NUMBER OF TREE										TOTAL	MEAN
	I	II	III	IV	V	VI	VII	VIII	IX	X		
1	865.5	865.5	1080.9	1506.5	1642.5	1063.7	872.3	1070.8	864.8	1047.4	10870.9	1087.09
2	1076.7	522.7	1031.5	1234.2	1836.7	962.7	814.8	992.6	1187.8	1062.7	10722.4	1072.24
3	1194.9	783.3	1058.9	1074.7	1628.8	1109.7	900.2	989.8	1148.6	1038.9	10927.8	1092.78
4	1159.8	766.6	1049.9	1200.6	1810.6	992.7	882.7	1015.4	1072.4	1053.4	11006.1	1100.61
5	1186.7	848.3	1028.4	1100.5	1724.6	1024.8	866.7	1061.2	1150.3	1045.5	11037.0	1103.70
Total	5483.6	3777.4	5249.6	6116.5	8643.2	5153.6	4336.7	5129.8	5425.9	5247.9	54564.2	
Mean	1096.72	755.48	1049.93	1223.30	1728.64	1030.72	867.34	1025.96	1085.18	1049.58		

Analysis of variance

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Trees	9	2,990,091.86	332,232.43	35.5385	2.12	2.88
Fruits	40	396,240.55	9,906.01			
Total	49	3,386,332.41				

L.S.M.D. = 128.96

TABLE 4

Thickness of rind in centimeters

FRUIT NO.	NUMBER OF TREE										TOTAL	MEAN
	I	II	III	IV	V	VI	VII	VIII	IX	X		
1	1.8	1.4	1.8	1.2	2.1	1.0	1.3	2.1	1.2	2.2	16.1	1.61
2	1.7	1.3	2.0	1.4	2.3	1.1	1.3	2.0	1.2	2.0	16.3	1.63
3	1.6	1.5	1.8	1.3	2.2	1.0	1.4	1.8	1.3	2.3	16.2	1.62
4	2.0	1.6	1.7	1.2	2.3	1.2	1.2	1.9	1.4	2.1	16.6	1.66
5	1.5	1.5	1.8	1.2	2.4	1.0	1.3	1.7	1.4	2.2	16.0	1.60
Total	8.6	7.3	9.1	6.3	11.3	5.3	6.5	9.5	6.5	10.8	81.2	
Mean	1.72	1.46	1.82	1.26	2.26	1.06	1.30	1.90	1.30	2.16		

Analysis of variance

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Trees	9	7.52	0.8356	58.43	2.12	2.88
Fruits	40	.57	0.0143			
Total	49	8.09				

L.S.M.D. = .153

TABLE 5

Weight of rind in grams

FRUIT NO.	NUMBER OF TREE										TOTAL	MEAN
	I	II	III	IV	V	VI	VII	VIII	IX	X		
1	316.5	399.2	395.8	642.1	745.2	362.1	314.8	384.9	311.3	419.6	4291.5	429.15
2	434.1	215.8	383.5	531.3	865.6	303.3	300.9	328.7	394.8	369.4	4127.4	412.74
3	479.4	390.8	383.5	395.6	772.8	373.7	332.7	320.3	384.9	380.2	4213.9	321.39
4	453.2	357.9	388.6	533.7	803.5	318.2	328.7	358.7	374.5	416.1	4333.1	433.31
5	540.3	376.8	342.4	482.3	792.6	320.0	319.6	368.2	379.6	422.2	4344.0	434.40
Total	2223.5	1740.5	1893.8	2585.0	3979.7	1677.3	1596.7	1760.8	1845.1	2007.5	21309.9	
Mean	444.7	348.1	378.7	517.0	795.9	335.4	319.3	355.1	369.0	401.5		

Analysis of variance

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Trees	9	913,295.46	101,477.27	38.35	2.12	2.88
Fruits	40	105,832.35	2,645.81			
Total	49	1,019,127.81				

L.S.M.D. = 6.6

TABLE 6

Number of segments

FRUIT NO.	NUMBER OF TREE										TOTAL	MEAN
	I	II	III	IV	V	VI	VII	VIII	IX	X		
1	11	12	14	11	12	12	14	15	14	14	129	12.9
2	12	11	14	12	12	12	14	15	15	14	131	13.1
3	12	11	14	12	12	12	14	15	15	15	132	13.2
4	10	11	14	12	12	12	15	15	14	14	129	12.9
5	11	11	14	11	12	12	14	15	15	14	129	12.9
Total	56	56	70	58	60	60	71	75	73	71	650	
Mean	11.2	11.2	14	11.6	12	12	14.2	15	14.6	14.2		

Analysis of variance

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Trees	9	104.40	11.60	61.05	2.12	2.88
Fruits	40	7.60	.19			
Total	49	112.00				

L.S.M.D. = .18

TABLE 7

Weight of rag in grams

FRUIT NO.	NUMBER OF TREE										TOTAL	MEAN
	I	II	III	IV	V	VI	VII	VIII	IX	X		
1	68.4	65.3	162.2	145.4	119.2	99.2	67.4	166.1	124.6	140.5	1158.3	115.83
2	75.7	56.7	150.1	149.2	113.3	124.4	64.1	157.2	185.9	98.7	1175.3	117.53
3	82.1	79.6	148.3	143.7	113.3	129.1	69.5	159.7	188.6	189.4	1303.3	130.33
4	87.2	87.4	132.0	140.6	118.7	132.3	66.4	160.1	158.9	142.4	1226.0	122.60
5	80.8	73.4	127.6	139.9	112.4	129.7	64.8	157.3	190.2	141.3	1217.4	121.74
Total	394.2	262.4	720.2	718.8	576.9	614.7	332.2	800.4	848.2	712.3	6080.3	
Mean	78.84	72.48	144.04	143.26	115.38	122.95	66.44	160.08	169.64	142.46		

Analysis of variance

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Trees	9	62,713.06	6,968.12	20.03	2.12	2.88
Fruits	40	13,915.14	347.88			
Total	49	76,628.20				

L.S.M.D. = 23.80

TABLE 8

Number of seeds

FRUIT NO.	NUMBER OF TREE										TOTAL	MEAN
	I	II	III	IV	V	VI	VII	VIII	IX	X		
1	29	79	124	64	61	75	74	130	116	127	926	92.6
2	11	84	107	68	87	64	83	113	142	82	841	84.1
3	31	82	102	37	93	61	104	128	133	170	941	94.1
4	21	88	114	31	102	61	98	146	121	173	955	95.5
5	19	80	102	40	96	68	116	84	129	171	905	90.5
Total	111	413	549	240	439	329	485	601	641	770	4568	
Mean	22.20	82.60	109.80	48.00	87.80	65.80	95.00	120.20	128.20	154.00		

Analysis of variance

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Trees	9	69,359.52	7,706.61	23.44	2.12	2.88
Fruits	40	13,150.00	328.75			
Total	49	82,509.52				

L.S.M.D. = 23.13

TABLE 9

Weight of seeds in grams

FRUIT NO.	NUMBER OF TREE										TOTAL	MEAN
	I	II	III	IV	V	VI	VII	VIII	IX	X		
1	9.7	17.8	39.3	28.5	30.2	23.5	17.2	42.3	44.5	34.6	288.6	28.86
2	4.3	17.8	38.9	29.7	54.2	25.6	18.0	36.4	64.2	16.1	306.2	30.62
3	15.8	17.5	40.2	17.2	41.6	28.3	44.2	40.6	61.3	32.8	339.5	33.95
4	8.8	20.2	43.2	13.4	58.1	27.6	39.2	52.0	49.4	34.1	346.0	34.60
5	8.6	18.3	47.6	18.6	44.3	30.2	25.1	27.4	60.3	33.5	313.9	31.39
Total	47.2	91.6	209.2	108.4	228.4	135.2	143.7	198.7	280.7	151.1	1594.2	
Mean	9.4	18.32	41.84	21.68	45.68	27.04	28.74	39.74	56.14	30.22		

Analysis of variance

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Trees	9	8,837.39	981.93	16.71	2.12	2.88
Fruits	40	2,349.90	58.75			
Total	49	11,187.29				

L.S.M.D. = 9.77

TABLE 10

Percentage of edible portion

FRUIT NO.	NUMBER OF TREE										TOTAL	MEAN
	I	II	III	IV	V	VI	VII	VIII	IX	X		
1	54.40	43.68	44.74	45.76	45.53	54.22	54.21	44.59	44.44	43.22	474.79	47.479
2	52.25	55.53	44.47	42.45	43.75	52.91	52.99	47.38	45.62	45.02	482.37	48.237
3	51.68	38.88	45.99	48.21	32.04	52.14	50.41	47.40	44.73	42.01	464.49	46.449
4	52.64	39.27	46.38	42.72	45.85	51.83	50.79	43.79	45.75	43.74	462.76	46.276
5	46.93	44.77	50.64	41.77	44.95	53.17	52.75	47.89	45.22	42.89	470.98	47.098
Total	257.90	222.13	232.22	220.91	223.12	264.27	261.15	231.05	225.76	216.88	2355.39	
Mean	51.58	44.40	44.43	44.18	44.62	52.85	52.23	46.21	45.15	43.37		

Analysis of variance

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Trees	9	600.88	66.76	8.71	2.12	2.88
Fruits	40	306.46	7.66			
Total	49	907.34				

L.S.M.D. = 3.513

TABLE 11

Titratable acidity in milliliters of N/10 NaOH per 100 milliliters of undiluted juice

NUMBER OF TRIAL	TAI TAO	FORTICH	SIAVER	SIAMESE PINK NO. 2	AMOY	SIAM (CONTROL)	TOTAL
1	147.60	83.40	127.20	100.80	84.80	212.80	756.60
2	139.20	85.20	126.80	106.40	86.40	182.00	726.00
3	140.00	86.00	126.00	101.60	84.90	224.00	762.50
Total	426.80	254.60	380.00	308.80	256.10	618.80	2245.10
Mean	142.266	84.866	126.666	102.933	85.366	206.266	

Analysis of variance

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Trees	5	31,719.50	6,343.90	75.13	3.11	5.06
Fruits	12	1,013.26	84.44			
Total	17	32,732.76				

L.S.M.D. = 12.24

TABLE 12

Amount of reducing sugar (as invert) in milligrams per 100 ml. of undiluted juice

NUMBER OF TRIAL	TAI TAO	FORTICH	SIAVER	SIAMESE PINK NO. 2	AMOY	SIAM (CONTROL)	TOTAL
1	629.61	389.92	394.63	502.00	394.67	457.82	2778.65
2	645.27	409.06	421.48	569.66	393.61	467.40	2906.48
3	641.02	398.45	398.45	475.80	400.64	456.44	2770.80
Total	1925.90	1197.43	1214.56	1547.46	1188.92	1381.66	8455.93
Mean	641.966	399.143	404.853	515.820	396.366	460.553	

Analysis of variance

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F-VALUE	TABULAR F-VALUE	
					1%	5%
Trees	5	139,369.20	27,873.84	61.77	3.11	5.06
Fruits	12	5,414.56	451.21			
Total	17	144,783.76				

L.S.M.D. = 3.84

TABLE 13

Juice-pulp ratio

VARIETY	JUICE	PULP	RATIO
Tai Tao	95.7	19.7	4.86:1
Fortich	113.9	38.3	2.97:1
Siaver	62.2	42.8	1.45:1
Siamese Pink No. 2	78.7	39.8	1.98:1
Amoy	124.2	34.2	3.63:1
Siam (control)	87.4	26.7	3.27:1

TABLE 14

Sugar-acid ratio

VARIETY	SUGAR	ACID	RATIO
Tai Tao	641.97	142.27	4.51:1
Fortich	699.14	84.87	8.24:1
Siaver	404.15	126.67	3.19:1
Siamese Pink No. 2	515.82	102.93	5.01:1
Amoy	396.37	85.37	4.64:1
Siam (control)	460.55	206.27	2.23:1

GOVERNMENT LIVESTOCK PROJECTS IN CENTRAL, NORTHERN, AND WESTERN LUZON [1]

VALENTE VILLEGAS

WITH ONE TEXT FIGURE

From October 27 to November 1, 1953, the writer, in company with Dr. John K. Loosli, visiting professor of animal nutrition from Cornell University at the UP College of Agriculture, Mr. James Robinson, animal husbandman of FOA, and Dr. Mariano Montemayor of the Bureau of Animal Industry, visited the livestock projects of the Central Luzon Agricultural College, agricultural and rural high schools, stock farms, breeding stations, breeding centers, and offices of provincial agriculturists in the provinces of Bulacan, Nueva Vizcaya, Isabela, Cagayan, Ilocos Norte, Ilocos Sur, La Union, Mountain Province, Pangasinan, and Tarlac. One private stock farm in Pangasinan was also visited.

CENTRAL LUZON AGRICULTURAL COLLEGE

Central Luzon Agricultural College is 3 kilometers from the municipalitiy of Muñoz, Nueva Ecija, and 151 kilometers from Manila. It has an area of 657.85 hectares. Recently, it acquired 1593 hectares of pasture land in Nueva Vizcaya. Approximately 1400 of its students are in the secondary school, and 567 are taking collegiate courses.

The college has 320 hectares planted to lowland rice, 12 hectares to sugar cane, 12 hectares to corn, 14 hectares to horticultural crops, and 5 hectares to upland rice. Ninety-five hectares are allotted to the swine herd which is composed of 470 head of Poland-China, Berkshire, and Duroc-Jersey grades. Five hectares are occupied by the poultry project with 1797 Single Comb White Leghorns, 309 New Hampshires, 205 turkeys, 90 ducks, and 6 geese. The college has 214 grade Indian buffaloes, 12 grade Red Sindhi cattle, 36 grade Toggenburg and Nubian goats, and 238 rabbits.

AGRICULTURAL SCHOOLS

Mountain National Agricultural School. This school is in Trinidad Valley, Mountain Province, a short distance from the city of Baguio. It has an area of 1900 hectares and an enrollment of approximately 1400, over 300 of whom are girls.

The school keeps about 10 horses, 12 native carabaos, 2 Holsteins, 1 Brown Swiss bull, 3 Red Sindhis, about 57 grade cattle, 12 sheep, 80 swine, 759 chickens, 20 Indian runner ducks, 6 Muscovy ducks, and 8 geese. The swine are of the Berkshire, Poland-China, and Hampshire breeds. Five hundred sixty of the chickens are Single Comb White Leghorns, 180 are New Hampshires, and 19 are Australorps.

[1] General Contribution No. 869.

San Carlos Agricultural High School. The best physical plant among the agricultural and rural high schools visited is that of the San Carlos Agricultural High School in San Carlos, Pangasinan. The school has an enrollment of 1048 students about equally divided into boys and girls. It has an area of 40.5 hectares.

The school has 10 carabaos, one of which is a Murrah carabao bull for breeding, 4 Red Sindhi cattle, 22 Berkshire swine, 10 sheep, 20 goats, about 60 rabbits, 300 Single Comb White Leghorn chickens, and 100 New Hampshire chickens. Two varieties of sweet potato, the Igorot variety with yellow tuber and the Angeles variety, are grown in the pastures for swine. Housing for swine is adequate, each class of pigs being provided with a shed, a feeding trough on a concrete floor, and a concrete wallow. Separate pastures are set aside for dry sows, pregnant sows, and weanlings. A maternity shed is also maintained.

Santa Maria Agricultural High School. This school in the municipality of Santa Maria, Ilocos Sur, covers an area of 24 hectares. The enrollment is around 500 students, about one-half of whom are girls. The school has 7 native carabaos, 2 work cattle, 6 Berkshires, and 60 layers of the Single Comb White Leghorn, New Hampshire, and Barred Plymouth breeds.

RURAL HIGH SCHOOLS

Batac Rural High School. This school is in Batac, Ilocos Norte. It has an area of 17.8 hectares, 6 hectares of which are planted to lowland rice. The school has an enrollment of 710 students, 350 of whom are girls. It has 7 Philippine carabaos, 1 native ox, 13 grade goats, 1 Berkshire boar, 1 grade Poland-China sow, 40 Single Comb White Leghorns, 15 New Hampshires, and 8 rabbits. One Red Sindhi bull and two heifers of the same breed were recently acquired from the College of Agriculture, University of the Philippines.

Camiling Rural High School. This school is 7 kilometers from the poblacion of Camiling, Tarlac. To its area of 26 hectares, 355 hectares are being added. It has 10 swine, all Berkshires, 87 Single Comb White Leghorns, and 28 New Hampshires.

Echague Rural High School. This school covers an area of 53 hectares in the municipality of Echague, Isabela. The enrollment is over 365. It has 6 Berkshires and several swine.

Nueva Vizcaya Rural High School. The school is in the municipality of Bayombong, Nueva Vizcaya. It has an area of 172 hectares, 18 hectares of which are planted to lowland rice. The school has a faculty of 15 and an enrollment of 280. It has 6 carabaos and 8 swine, of which 5 are Berkshires, 2 Duroc-Jerseys, and 1 Hampshire. It also keeps rabbits.

CAGAYAN PUBLIC HIGH SCHOOL

Cagayan High School. Swine at the Cagayan High School in Tuguegarao, Cagayan, are properly housed and fed. As a result

the animals, even though standard purebreds, have produced well. One Duroc-Jersey sow, four years of age, has produced three litters. The school also has a pair of Hampshires; the sow is four years old. The rest of the pigs in the school are grades.

STOCK FARMS

Bongabong Stock Farm. The Bongabong Stock Farm is one of the principal stock farms of the Bureau of Animal Industry. It is located in the municipality of Bongabong, Nueva Ecija, and has an area of 4300 hectares. Much of the area is grass pasture land, grown mostly to cogon and silibon (*Themeda triandra* [Cav.] Hack.). The land is undulating, hence, well-drained. Alabang X (*Andropogon nodosus* [Wilhelm.] Nagh.) grows well on the farm.

Most of the prize breeding stock of the Bureau of Animal Industry are kept on this farm for breeding and for research. Four breeds of cattle are on the farm. There are 16 head of the Bhagnari breed, 28 Brahmans, 49 Harrianas, and 59 Red Sindhis. There are also 27 head of Brown Swiss cattle, 34 Murrah carabaos, 21 Shropshire sheep, 15 Jamnapari goats, and 108 Berkshire swine.

Baguio Stock Farm. Five kilometers from the city of Baguio in the barrio of Santo Tomas is the Baguio Stock Farm. It sprawls over a rolling terrain of 95 hectares of grassland, samon (*Themeda triandra* [Cav.] Hack.) being the predominating grass. In it are 25 Jersey cattle and 2 Cambodia carabaos. Napier grass, Gordura grass, Alabang X, Dallis, Kikuyu grass, and clover are grown on the farm. Napier grass is cut and fed to the animals in the barn.

BREEDING STATIONS

Ilocos Norte Breeding Station. This station is located in the municipality of Dingras, Ilocos Norte. It has an area of 20 hectares. The beautiful chestnut Arab stallion, Pekah (fig. 1, upper panel), is kept here for breeding purposes. The station also has 1 Murrah carabao bull, 26 Tharparkar cattle, 6 Persian sheep (fig. 1, lower panel), 1 Dumba ram, 6 Alpine goats, and 24 rabbits. The breeding pens house 1 Duroc-Jersey and 5 Berkshires. Twenty other swine are in the outlying pastures. Forage plots of different species, including the Cambodian mungo, are maintained. An extensive planting of ipil-ipil for forage has been made.

Ilocos Sur Breeding Station. The breeding station at Santa Maria, Ilocos Sur, was recently transferred to San Ildefonso in the same province. The station has an area of only 8.5 hectares. More land should be acquired to make the station adequate. In the station are 5 Sahiwal cattle, 3 native carabaos, 7 Berkshire swine, and 110 New Hampshire layers.

Nueva Vizcaya Breeding Station. This station in Bayombong, Nueva Vizcaya, has an area of 20 hectares. It has 1 Quarter Horse stallion, 2 Cambodia carabaos, 1 Brown Swiss bull, 22 Sahiwal cattle, 2 grade Red Sindhi cattle, 36 Duroc-Jersey swine, three Berkshire

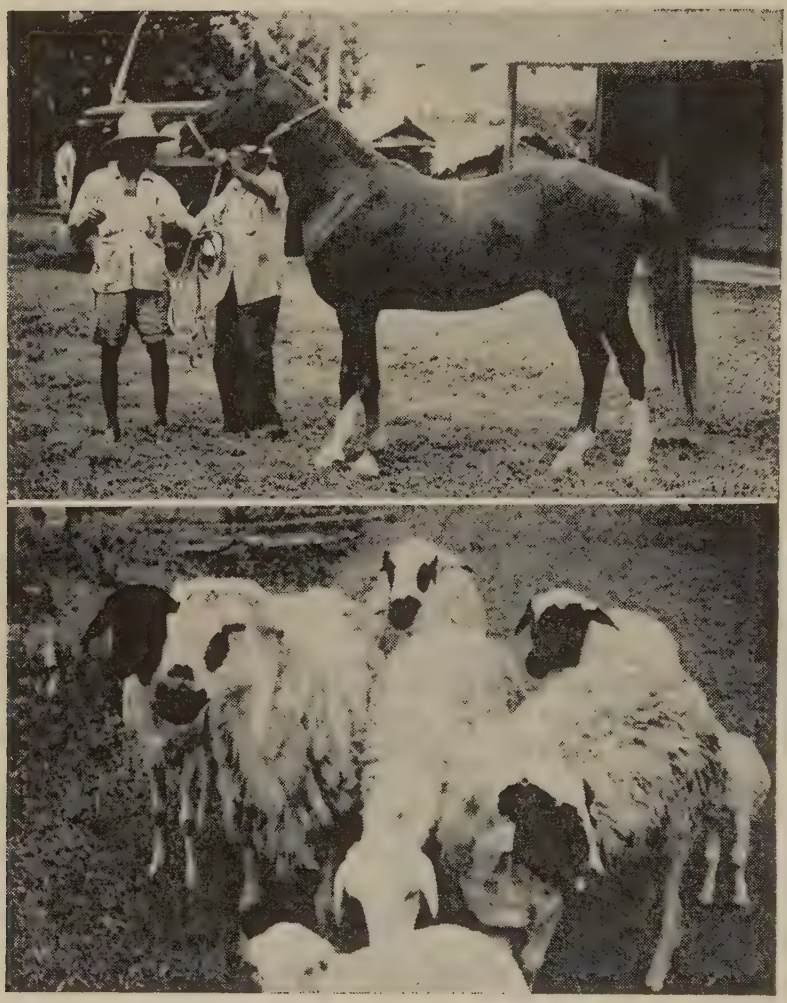

Fig. 1.—Upper panel, Pekah, an Arab stallion at the Ilocos Norte Breeding Station, Dingras, Ilocos Norte. Lower panel, Persian sheep at the Ilocos Norte Breeding Station. (*Courtesy of Dr. J. L. Loosli.*)

swine, and 1 Hampshire boar. Cattle in this station are allowed to graze on an adjoining pasture of about 100 hectares belonging to the Bayombong Rural High School.

The station has well-kept plots of introduced forages such as Colonial Guinea grass, Delhi grass, molasses grass, Kolokotai, finger grass, Dallis, Alabang X, Pangola, ordinary Guinea grass, Napier grass, Merker grass, Green Panic, Guatemala grass, uba cane, *Andropogon intermedius R. Br.*, and Cabello de Negro.

La Union Breeding Station. This station is in Paraoir, Luna, La Union. It has an area of 20 hectares. In it are 29 Red Sindhi cattle, 3 Murrah carabaos, 1 Berkshire, 20 Poland-China swine, and 105 Single Comb White Leghorn chickens. *Pennisetum setosum* (Swartz.) L. Rich. is abundantly raised on the station. Guinea grass is also grown for soilage purposes. Malungay trees, *Moringa oleifera* Lam., are used as fence posts. The leaves of malungay are used as greens for swine and poultry and as vegetable for human consumption. Limestone is scattered over the pens in this station.

Pangasinan Breeding Station. This station is in a range area in Sual, Pangasinan. It extends over 80 hectares of rolling country with cogon as the principal pasture grass. Samon also grows in the pastures. The station has 4 Murrah carabaos, 18 grade Murrahs, 4 Philippine carabaos, 30 Red Sindhis, 30 Tharparkars, 3 Berkshires, and 200 rabbits. A large variety of forages, including the African acacia forage tree and *Sesbania aegyptica* (F. Villar), are raised. An extensive luxuriant cover of tropical kudzu (*Pueraria javanica* Benth.) has been established on the pastures.

Tarlac Breeding Station. This station is in the municipality of San Miguel, Tarlac. It has an area of 42.1 hectares. The grade stallion Buhawi is in this station, togeher with 1 Murrah carabao, 4 Philippine carabaos, 61 head of Jersey, Red Sindhi, and grade Jersey cattle, 64 swine of the Berkshire, Duroc-Jersey, and Hampshire breeds, 163 chickens of the New Hampshire and Single Comb White Leghorn breeds, 24 Pekin ducks, and 57 New Zealand white rabbits. Pasteurized milk from the dairy cows of the station are sold at 60 centavos a liter. Forages are grown in demonstration plots. In addition, 2 hectares of bungalon (*Echinochloa stagnina* Beauv.) are maintained in paddies as soilage material. The station has a concrete pit silo in which sugarcane tops are conserved for periods of feed shortage in the dry season.

Santa Barbara Breeding Center. This breeding center, rated as one of the best stocked and managed centers of the Bureau of Animal Industry, occupies an area of 5 hectares in the municipality of Santa Barbara, Pangasinan. It has 3 carabaos, one of which is a Murrah carabao bull, the second a Cambodian, and the third a grade Murrah; 1 Tharparkar bull; 19 swine, of which 4 are Berkshire boars and 4 are Berkshire sows; and 90 Single Comb White Leghorn chickens. Alabang X is grown extensively. Native sweet potato is also raised for swine feeding.

Santa Maria Breeding Center. This breeding center adjoins the Santa Maria Agricultural High School. It has an area of 8 hectares and keeps 6 Tharparkar cattle, 1 Murrah carabao bull, 1 Cambodian carabao, 4 Berkshire boars, 7 Berkshire sows, and 160 Single Comb White Leghorn chickens. The Berkshire boar with the best conformation and size in all the stations visited is in the Santa Maria breeding center.

OFFICES OF PROVINCIAL AGRICULTURISTS

In Cagayan the office of the provincial agriculturist is in Tuguegarao and is headed by Genaro M. Baquiran, '33. Salvador T. Pacion, '30, is district agriculturist for Cagayan, Isabela, Nueva Vizcaya, and Mountain Province. The office has 3 Berkshires for breeding purposes.

In Ilocos Norte the office of the provincial agriculturist is in a nursery of 1.8 hectares in Laoag. Francisco F. Saguiguit, '40, is the provincial agriculturist. His staff consists of two assistant agronomists, a provincial fertilizer supervisor, and a junior fertilizer supervisor. This office has put out one Harriana bull to breed privately owned cows and three bucks of improved blood to improve the native goats. It has one Berkshire boar.

In Ilocos Sur the office of the provincial agriculturist is in Vigan. The provincial agriculturist is Andres F. Tolentino, '24, and the district agriculturist who has charge of Ilocos Norte, Ilocos Sur, La Union, Abra, and Batanes is Constante V. Valera, '35. The province has an assistant provincial agriculturist, a supervising plant inspector, and a man in charge of 4-H clubs of the district. The office has 2 Murrah bulls for distribution, 1 for Ilocos Sur and 1 for Abra. It has also 3 Harriana bulls and 7 goats for breeding.

In Isabela the office of the provincial agriculturist is in Calamagui and is headed by Bonifacio M. Manaligod, '36. Assisting him are an assistant provincial agriculturist and an associate agriculturist. The office has 2 Murrah carabaos, 3 Harriana cattle, Anglo-Nubian goats, and 1 Berkshire for breeding.

In La Union the office of the provincial agriculturist is in San Fernando. The provincial agriculturist is Pio A. Tadina, '38. The other personnel in the office are a provincial fertilizer supervisor, an assistant provincial agriculturist, and a junior fertilizer supervisor. Three Berkshire boars and 2 Berkshire gilts are kept in the office for breeding.

The office of the provincial agriculturist in Tarlac is headed by Narciso S. Sibal, '34. The nursery of the office is 4.5 hectares in area and has 1 Murrah bull, 1 buck, 2 Berkshire boars, 1 Berkshire gilt, and 5 New Zealand White rabbits.

PRIVATE STOCK FARM

The stock farm of Mr. Juan Lomibao in Guiguisangen, Mangaldan, Pangasinan, has 20 swine, of which 2 are Berkshire boars. It also keeps approximately 300 Nichol's Red chickens and 1000 Single Comb White Leghorns. The farm makes kerosene-heated incubators of different sizes. The smallest-sized incubator has a capacity of 300 eggs and is priced at ₱140. Next is the 360-egg incubator which is priced at ₱160. The third and largest incubator can contain 420 eggs and is sold at ₱200.

COLLEGE AND ALUMNI NOTES

President Vidal A. Tan awarded diplomas to 38 graduates of the UP Rural High School during its twenty-third commencement exercises on April 3, 1954. Three students graduated with honors in the boy's curriculum: Deomund B. Aglibut, valedictorian, and Leopoldo M. Villegas and Francisco C. Eala, honorable mention. Hon. Eulogio Rodriguez, Jr., '25, congressman from Rizal, was the commencement speaker.

Dean L. B. Uichanco was the guest of honor and speaker at the commencement exercises of the Los Baños High School (Grinhar College) on April 2, 1954.

Drs. N. C. Brady, N. L. Galvez, G. C. Kent, A. G. Newhall, H. K. Hayes, D. L. Umali, and F. T. Orillo attended the abacá conference in Davao on March 11-12, 1954. Drs. Galvez and Brady stayed up to March 16 to collect soil samples and soil monoliths from the area.

The staff of the Department of Plant Pathology gave a luncheon on March 15 as a despedida for Dr. and Mrs. G. C. Kent and a bienvenida for Dr. and Mrs. A. G. Newhall. The Kents are returning to Cornell after working in the College for 18 months. Dr. Newhall succeeds Dr. Kent in the department.

The Kents were also honored with a farewell party by the Maquiling Ladies' Club on March 20, 1954, at the Rural High School Auditorium.

Dr. Jose Villa Panganiban of Santo Tomas University was the guest speaker at a *timpalak-talumpatian* which was held by the UPRHS "Diwa at Panitik" on March 28, 1954, in connection with Filipino Language Week. Winners in the oratorical contest were Nelia Evangelista, Roberto Monserrat, and Romeo Samiano.

Dr. F. M. Sacay was appointed member of the National Agricultural Council by President Magsaysay on March 30, 1954. He was also appointed consultant to the presidential land tenure committee.

Dr. Sacay presented a paper on March 30, 1954, at the teacher-education workshop held at the UP College of Education in Diliman.

The following papers were presented at the regular scientific meeting of the Los Baños Biological Club on March 26, 1954: (1) "On the natural occurrence of two crystalline forms of vanillin," by Miss Aurora T. Violanda of the Department of Agricultural Chemistry; (2) "Cinchona canker incidence in relation to Cinchona seedling wilt and blight diseases caused by *Phytophthora cinnamomi* Rands," by Prof. E. F. Roldan of the College of Forestry.

The Department of Physical Education held its annual Lettermen Day on March 9, 1954. Featured in the program were a folk dance and rhythmic gymnastics. Pennants, medals, and letters were awarded by Dean L. B. Uichanco, Prof. G. Zamuco, and Prof. A. B.

Catambay to the winners of various athletic events. Mr. W. Mendoza, assistant physical director, and Miss L. D. Yñiguez took charge of the affair.

The Department of Military Science and Tactics, UP Los Baños College, held its turn-over and graduation exercises for second year advanced and basic cadets on March 23, 1954. Col. Salvador Abcede delivered an address and awarded diplomas to 13 graduating second year advanced cadets, and Dean L. B. Uichanco pinned medals of honor on deserving cadets. Major Virgilio T. Almeda is the commandant of the Los Baños ROTC unit.

The UPRHS held its annual high school day on March 31, 1954. Main features of the program were vocational and academic contests, Boy Scout skill contests, P.M.T. drill competition and pass-in-review, and a Tagalog dramatic contest.

The College Senior Class Organization honored its graduating members with a farewell dance on March 26, 1954, at the Seniors' Social Garden. Prof. N. B. Tablante is the adviser and Mr. Marcos R. Vega, the president of the organization.

The UP Rural High School celebrated its Silver Jubilee with an anniversary ball on April 3 and a faculty-alumni luncheon on April 4, 1954. The following alumni were awarded certificates of merit: Dr. A. M. Dalisay, for outstanding services to the country; Miss Clare Baltazar, for outstanding scholarship; and Mr. Victoriano G. Rivera, for outstanding success in farming. Dr. Francisco M. Sacay, who served as principal from 1931 to 1953 in addition to his other duties, was awarded a certificate for continuous and meritorious service to the UP Rural High School. Mr. Martin V. Jarmin is the president of the UPRHS Alumni Association.

Mr. Eligio J. Tavanlar, '26, was inducted by President Magsaysay at Malacañan on March 30, 1954, as member of the National Agricultural Council. Mr. Tavanlar is also chairman of the Presidential Committee on land tenure, chairman of the board of directors of LASEDECO, and chairman of a number of investigational committees.

In a meeting on March 25, 1954, the College faculty approved to recommend the graduation of 76 seniors with the degree of Bachelor of Science in Agriculture, 5 with the Certificate in Agricultural Education, and 3 with the title of Associate in Agriculture. Three students graduated with honors: Orlando J. Sacay, *magna cum laude;* Concepcion L. Valera and Marcos R. Vega, Jr., *cum laude.* Orlando J. Sacay was awarded the Joaquin J. Gonzalez medal.